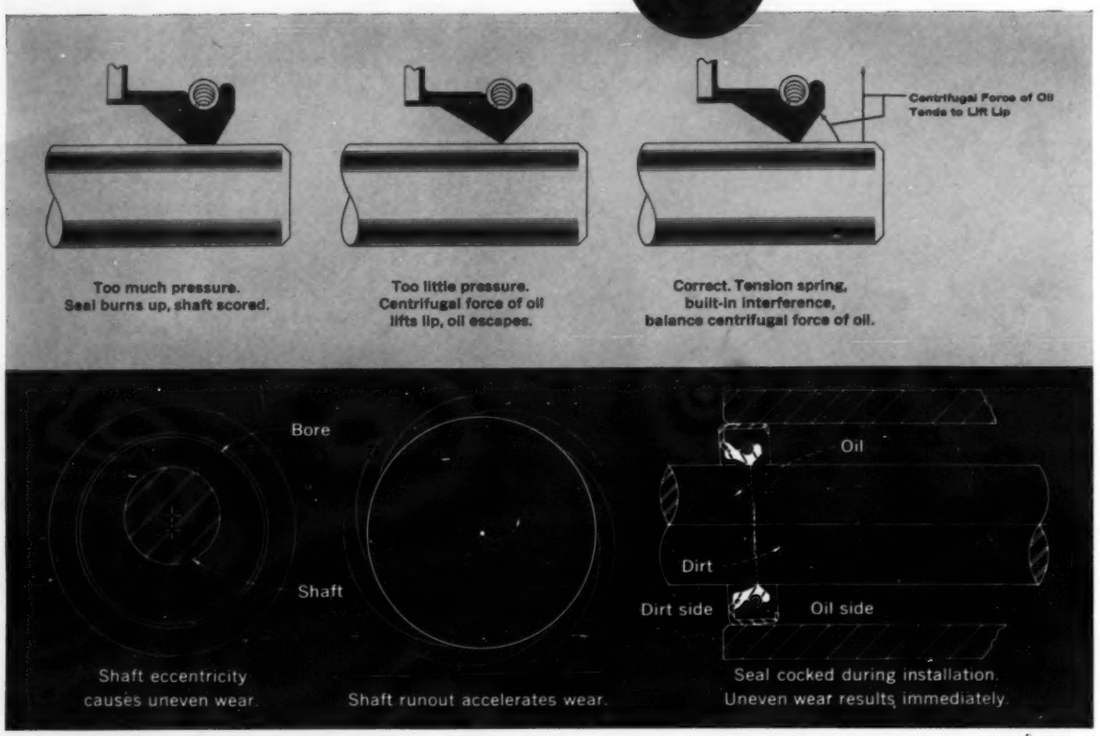
Design News

Pivoting frame with cycling seal bar simplifies radioactive capsule testing. P. 80

A CAHNERS PUBLICATION

JUNE 5, 1961

Lip pressure...too much or too little, and you've a leaker for sure!


Centrifugal Force of Oil Tends to Lift Lip
Too much pressure. Seal burns up, shaft scored.
Too little pressure. Centrifugal force of oil lifts lip, oil escapes.
Correct. Tension spring, built-in interference, balance centrifugal force of oil.
Bore
Shaft
Shaft eccentricity causes uneven wear.
Shaft runout accelerates wear.
Oil
Dirt
Dirt side
Oil side
Seal cocked during installation. Uneven wear results immediately.

Ideal sealing conditions are (1) shaft in bore center, (2) no runout, (3) seal not cocked, (4) seal concentric, (5) bore round and smooth, (6) shaft round and properly finished, (7) seal proper size.

Meeting these conditions is complicated, frequently requires special seal design or the specialized knowledge of National Seal engineers.

Sealing problems should be anticipated and answered on the board, not in production. Why not call your National Seal engineer now about your current project. He's in the Yellow Pages, under Oil Seals or O-Rings.

NATIONAL SEAL
Division, Federal-Mogul-Bower Bearings, Inc.
GENERAL OFFICES: Redwood City, California
PLANTS: Van Wert, Ohio; Redwood City and Downey, California

6960

Circle 1 on Reader-Service Card for more information

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Design News

ENGLEWOOD, COLORADO

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QUAD·RINGS®

- POSITIVE SEALING UNDER ALL CONDITIONS
- ELIMINATES ALL SPIRAL TWIST FAILURE
- FOUR FLEXIBLE SEALING SURFACES
- LOW FRICTION INSTALLATION
- HIGH DENSITY INJECTION MOLDED
- RUBBER COMPOUNDS TO FIT APPLICATION

POSITIVE SEALING UNDER ALL CONDITIONS—The MR QUAD-RING gives superior sealing in reciprocating, rotary, and static applications at pressures ranging from 0 on up.

ELIMINATES ALL SPIRAL TWIST FAILURE—This costly cause of O-ring failure is eliminated because the relatively square cross-section of the QUAD-RING will not roll.

FOUR FLEXIBLE SEALING SURFACES—give double the sealing effectiveness of the O-ring because of the exclusive seal design. It prevents leakage and requires less squeeze.

LOW FRICTION INSTALLATION—is made possible because of the exclusive quadrilateral design. This permits much higher rotary speeds and gives the seal much longer life.

HIGH DENSITY INJECTION MOLDED—All QUAD-RINGS are molded by MR's exclusive injection molding process to give an exceedingly dense product. There are no voids to cause seal failure.

RUBBER COMPOUNDS TO FIT APPLICATIONS—MR compounds are designed to give the best possible service, using basic polymers such as natural or synthetic rubber, silicone or any other that will perform best under the specific conditions.

QUAD-RINGS are manufactured under U.S. patents RE 24332 and 2,873,132

FOR MORE INFORMATION ON QUAD-RINGS AND A COPY OF THE MINNESOTA RUBBER FACT BOOK . . .

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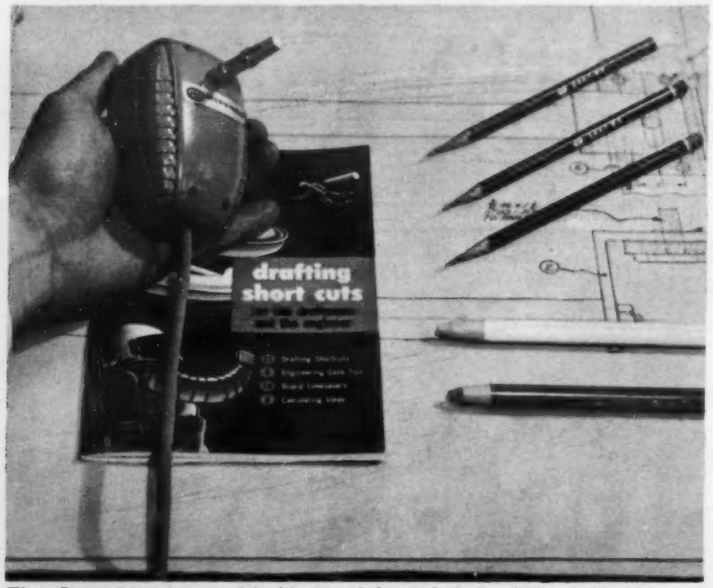

Three POST aids to increased drafting speed shown clockwise: Self-switching Mercury electric eraser; Triangular-shaped Try-Rex drawing pencils; Peel-off eraser sticks.

New drafting conveniences increase efficiency

Mercury Electric Eraser—Try the full-automatic Mercury eraser for really effortless corrections—it turns *on* when you pick it up, turns *off* when you put it down. So quiet and vibration-free that it takes a touch of the high speed shaft to convince you its interference-free motor is running!

Furnished with an assortment of eraser tips suitable for fast, smooth removal of soft or hard pencil lines, typewritten material, even printing. Accurately erases a one-letter typing error, yet speedily removes large areas of an engineering tracing. Palm-fitting, easy to handle. Durable plastic housing with non-slip finger grips makes erasing a pleasure instead of a chore. The low, $16.50 price is quickly paid for in time and trouble saved.

Try-Rex Drawing Pencils—Embodying the first new pencil design in years, a rounded, triangular casing, the Damascus Try-Rex pencil provides more than a relaxed and comfortable grip. Its three flat sides not only fit the controlling three fingers, but indicate to the draftsman a succession of 120° stops which help position the pencil for uniform line weight and density. Precise grading of lead hardness, plus color-tip coding, further aid production of better tracings and clearer prints.

Pencil-Style Eraser—An eraser capable of hairline control often saves re-drawing of fine detail in small-scale work. For such precise work, there's nothing better than a POST 2934 Pink Pearl eraser, now available in peel-off, self-sharpening pencil style. The POST 2933 Magic-Rub is also a paper-wrapped, peel-off type, but provides a white vinyl tip for clean erasing of drafting film. Both give real convenience when exacting erasure is needed.

Further information on all of these worthwhile POST drafting aids is available from your nearest POST dealer. Or, write Frederick Post Company, 3640 North Avondale Avenue, Chicago 18, Illinois.

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SOUNDING BOARD

FOR OUR READERS

Long Day

In your April 24 issue there is an article by C. O. Lubatti concerning a clock-calendar developed in Italy. The illustration given shows 58 hours and 12 minutes for Feb. 29. They certainly have long days in Italy.

JOSEPH A. TONINI
Project Engineer
Micro Switch
Freeport, Ill.

• Callouts were unfortunately reversed.

Metric System

I am certain you will want to call to the attention of your readers the desirability in their support of bill HR269 which was introduced by Congressman James Roosevelt in the House of Representatives. This bill authorizes a study into the practicability and desirability of the United States adopting the metric system of weights and measures.

As you know, a large majority of all scientists and engineers have been in support of adopting the metric system of weights and measures for many years.

R. M. MEHL
Chief Engineer
McClintock Mfg. Co.
Whittier, Calif.

The longing for the Metric System is still in many minds. In some ways it is too bad that the French did not win the War of 1812 instead of the British. Had the French won, the French language would have predominated on the North American continent, and presumably we should have had the Metric System too. In the latter case we should have been ahead of the mother country, France itself. For in France it took more than 50 years after the invention of the Metric System for it to replace the "systeme usuel" or old system. The S. U. had to be interdicted by law in France in 1840.

All Metric System principles take time to resolve. It took from 1893 to 1960 for the International Committee on the Meter to define the length of the metal meter bar standard in terms of a wavelength of light.

Now the Metric System faces a new dilemma—the advent of new units in the English system, namely the "international yard" and the "international pound." In Britain today the question is whether these new international units will be defined by Parliament in terms of the "Imperial" units or the metric units. Further, another problem which has arisen in Britain is whether the "Imperial" units should be renamed "Commonwealth" units, since many things once termed "Imperial" are now designated "Commonwealth".

WILLIAM E. BULLOCK
Freeport, N. Y.

B-58 Escape Capsule

We note with interest the description on page 83 of your issue of April 24, covering the B-58 Escape Capsule. The article is highly factual but we feel there is one glaring omission. Nowhere is it mentioned that this escape capsule is designed and built by Stanley Aviation Corp. for Convair, Fort Worth. Since Stanley Aviation is almost in your back door, we are somewhat hurt that no mention was made of our part in what is a definite advance in the state-of-the-art for providing a complete survival medium for man when it becomes necessary to escape from a supersonic aircraft.

R. G. ERVIN, JR.
Manager, Customer Relations
Stanley Aviation Corp.

Engineer in a Cocoon

There is a great deal of truth in what was written about the engineering profession by both Mr. Palley and yourself. Fortunately, though, there are always two sides to a story. If it is true that engineering is weaving a cocoon around itself in security and fringe benefits then to us this indicates that there is a need for this security. If you want creative engineering then take this worry of security for themselves and their families away from them and they will be free to create new ideas.

Second, maybe we are getting the wrong idea about what you said about draftsmen, but what is your interpretation of a "peon"? Webster's definition is as follows: "A pawn in chess, a foot traveler, an attendant, in Spanish America a member of the laboring class (orig.) one forced to serve virtually in bondage to creditors." Take your pick of any of the above definitions and it all comes out the same. We as draftsmen resent the fact of being called peons. Is not the drafting board the operating table of the engineering profession where ideas are put down on paper and made practicable, and then sent on to be made a reality in the shops? . . .

MICHAEL RIOTTO
Paterson, N. J.
Rodger McIninch
East Paterson, N. J.

• Sorry—no offense to much-needed draftsmen intended!

Ideas and Problem Solutions

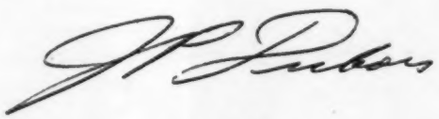
In the preface of the Design Show Guide are these words: "You never know, until you look, just where you will find not only a solution to one of your current design problem, but *new ideas* that will give you fresh approaches to many original design concepts."

This brief statement on the aims of the show warms my editorial heart. For the aims of the show are the same as the aims of DESIGN NEWS.

Trade shows exist for the sole purpose of providing new ideas. After walking up and down the numerous aisles in Cobo Hall, I can testify to the large number of ideas on display. There are far too many for any one person to assimilate. Likewise, it is impossible to walk away from a show of this type without assimilating at least one idea that can be of immediate use in solving a design problem.

DESIGN NEWS is like that. Our Design Idea concept is based on the same principle as the Design Engineering Show. Each issue contains a large number of ideas, any one of which just might stimulate a train of thought that can lead to the solution of your current design problem. Thus, in effect, each issue of DESIGN NEWS is a sort of tour through a trade show. In each major article you might find just the idea you need to trigger the solution to a problem, just as you might find the same idea in the booth of an exhibitor.

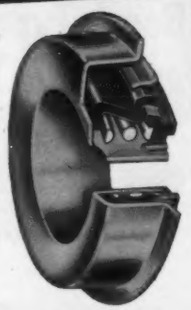
I am always interested in reader reaction to articles. Drop me a line when we have provided the germ of a problem solution, or if I can be of any help in suggesting any other ideas, let me know that too. My job, like that of all the DESIGN NEWS edittors, is to be of service to you.



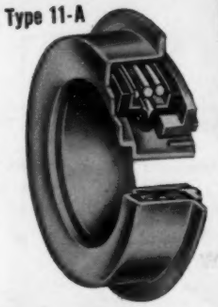
Executive Editor

3 JOHN CRANE "Pressed-In" SEALS
for economy, quick installation and life-long performance in all types of service

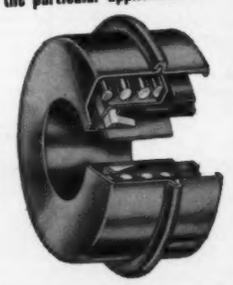
TYPE 11-A
Synthetic Rubber Bellows • Small shafts to ¾ in.
Services: hot or cold water, oil, gasoline, kerosene and other liquids non-injurious to synthetic rubber.
Pressures: up to 50 psi.
Temperatures: –65°F. to +220°F. Special construction to +300°F.
Construction Data: Packaged unit. Retainer does not contact shaft, permitting operation at a high rpm. One size can be used for several shaft sizes. Bellows encloses spring and metal parts to prevent contact with medium being sealed.



TYPE 6-A
Synthetic Rubber Bellows • Interchangeable with Type 11-A
Services: hot or cold water, oil, gasoline, soapy and other liquids non-injurious to synthetic rubber.
Pressures: up to 75 psi.
Temperatures: –65°F. to +220°F. Special construction to +300°F.
Construction Data: Similar to Type 11-A. Does not contact shaft, permitting operation at high rpm. One size can be used for several shaft sizes. Spring and metal parts available in stainless steel or bronze.



TYPE 9-A
Sealing Members Made of Teflon* • Engineered for the particular application
Services: all chemicals, solvents, oils, corrosives and gases, hot or cold.
Pressures: to 150 psi. Balanced construction to 750 psi.
Temperatures: –120°F. to +500°F.
Construction Data: Packaged unit. Furnished in metallurgical specification best suited to the application. Chemically-inert Teflon wedge ring closely fits inner sleeve of retainer and is machine-mated to carbon sealing washer.



Contact "John Crane" for the shaft seal best suited to your requirements. Request bulletin giving full information on "John Crane's" complete line of mechanical seals.

Crane Packing Co., 6423 Oakton St., Morton Grove, Ill., (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

**DuPont trademark*

John Crane CRANE PACKING COMPANY

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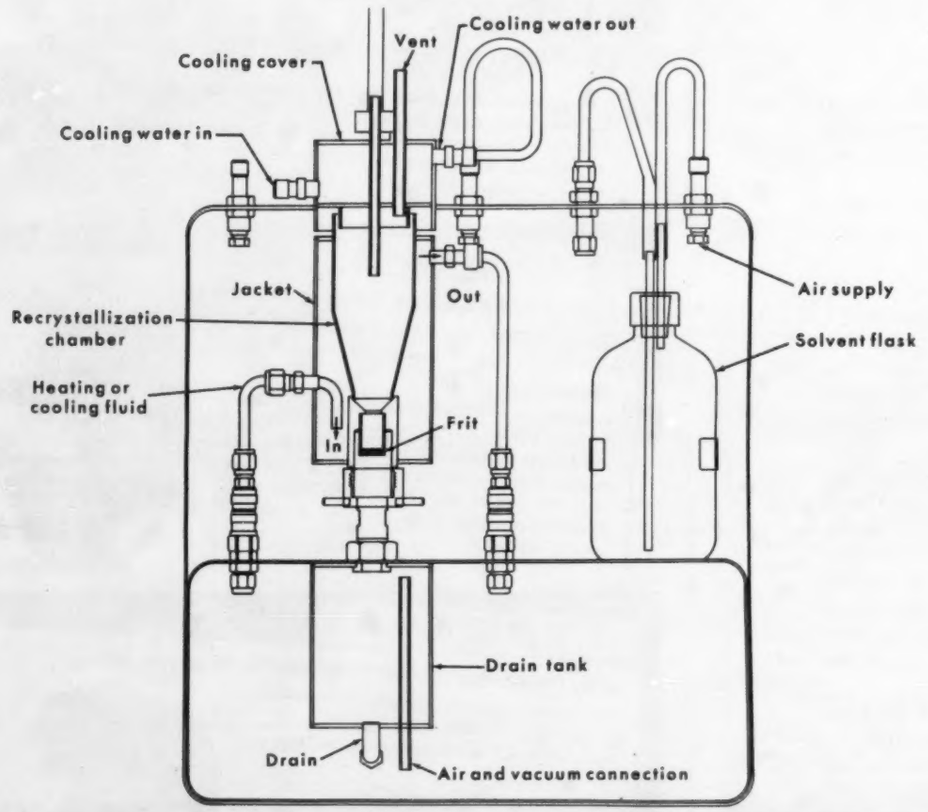
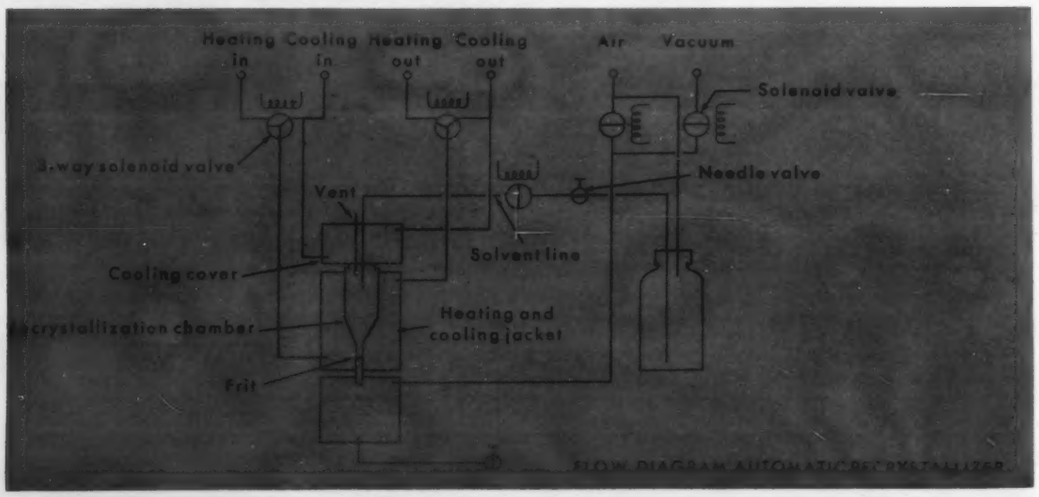
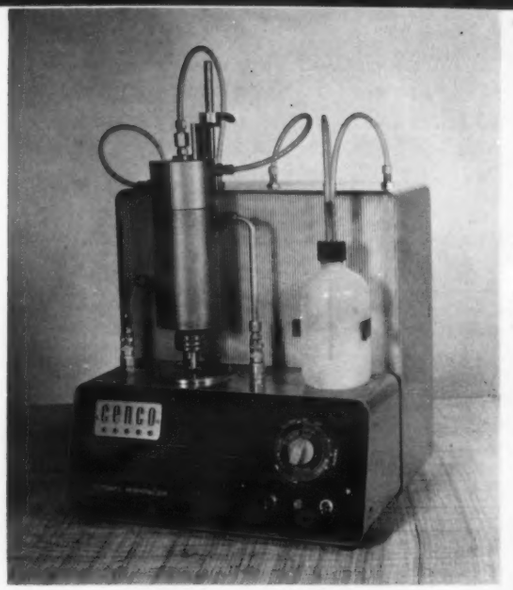
DESIGN ENGINEERING NEWS

Bench-Type Recrystallizer Purifies Inorganic Compounds

Lars G. Soderholm, Midwest Editor







CHICAGO, ILL.—An automatic recrystallizer permits soluble inorganic compounds to be purified to a high degree in a single-cycle or repeated-cycle operation. The material to be purified is dissolved in a solvent, heated, chilled until recrystallized and finally washed and dried.

The automatic recrystallizer is expected to be particularly useful in cases where very pure materials are necessary for analysis, comparison or inspection in testing or control work. It enables the user to upgrade economical low-grade compounds or materials that deteriorate in shipping or with storage immediately before use.

In operation, the material to be purified, in crystalline or powder form, is placed in the recrystallization chamber and a water-cooled cover is clamped over it. Air presure then is applied to the drain tank below so that it passes up through a pressed stainless steel frit and the recrystallization chamber. A measured amount of solvent is sprayed into the chamber from a pressurized solvent bottle. Hot water in the jacketed section around the chamber and agitation from the air bubbling through the frit cause the sample material to dissolve in the solvent.

When the material is all in solution, the hot water in the jacketed section is replaced by cold water. As the solution becomes supersaturated, air bubbles provide nucleation for the growth of relatively pure crystals. After enough crystals are out of solution, the agitating air is shut off and a vacuum is applied on the drain tank to pull off the mother liquor. Three solvent rinses wash the crystals after which air and heat are applied to dry the crystals.

Type 316 stainless steel parts are used in contact with the sample material. A pint-sized polyethylene container is the solvent reservoir.

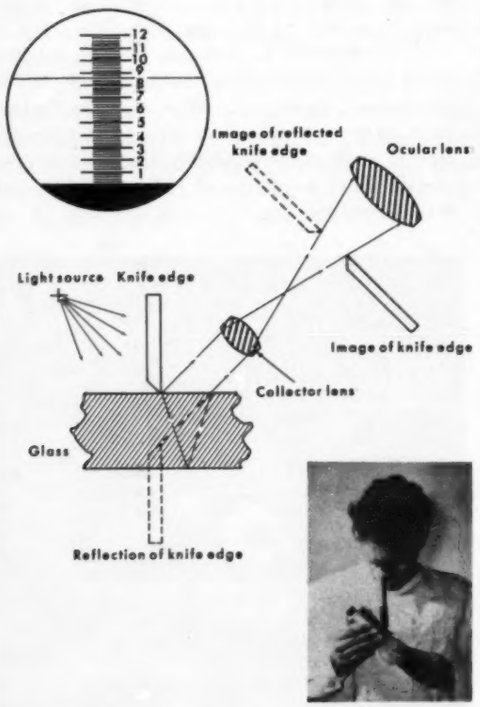
The Cenco Automatic Recrystallizer is manufactured by the Central Scientific Co.

Image of Knife Edge Aids Glass Measurement

R. F. Stengel, German Editor

BAD KREUZNACH, GERMANY—The thickness of glass walls is measured from one side by utilizing the image of a knife edge. A newly developed meter combines a simple lens system with a fixed edge set at 45 deg. The distance between the edge and its image in the glass is directly proportional to wall thickness.

An entire surface can be checked continuously; the black shadow of the edge projection always remains at the zero mark of the measuring reticule. Any transparent material can be checked. Standard meter version ranges from 0.2 to 12 mm with ±0.1-mm accuracy; smaller version covers 0 to 1.2 mm range with 0.01-mm accuracy. Both are developments of Dr. Heinrich Schneider, Optotechnische Fabrik.



KNIFE EDGE touches glass to be measured. Light source generates reflection of knife edge in glass. At 45-deg angle, knife edge and reflection are viewed together. Collector lens projects images into focal plane of ocular lens, where both are seen on calibrated reticule. Reticule is calibrated in steps of 0.2 mm. Superimposed shadow of knife edge (black) and reflection of knife edge permit direct reading of wall thickness (example shown: 8.6 mm).

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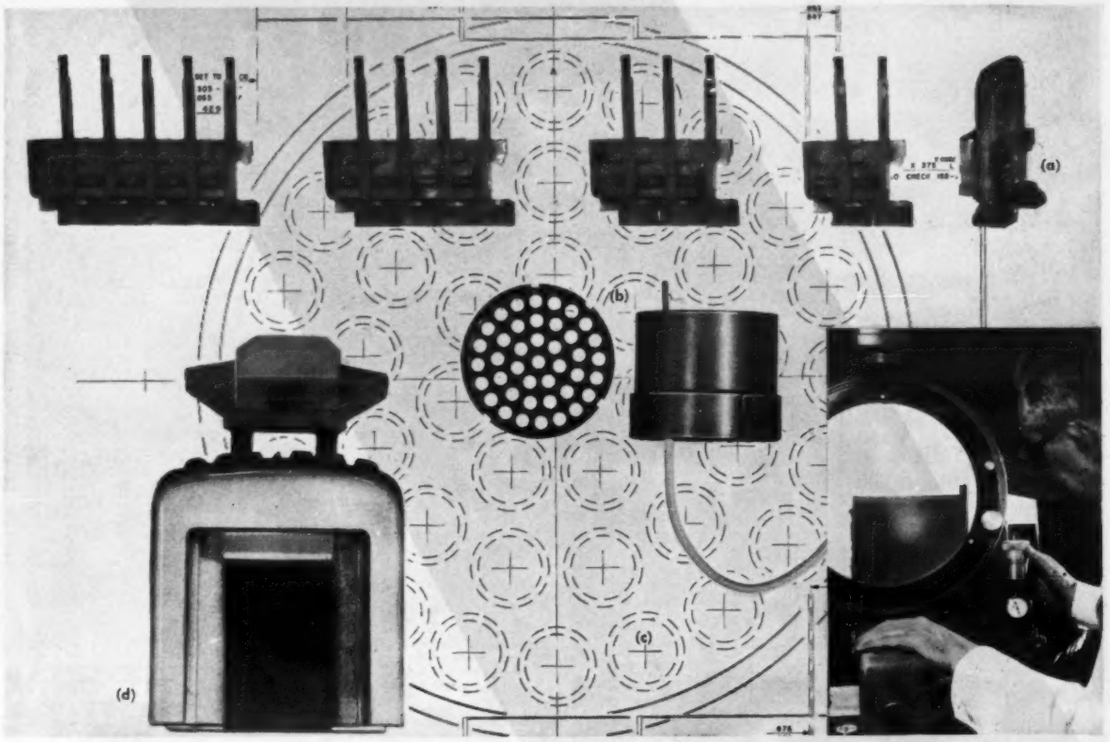

(a) A series of crab locks molded from Nylon.
(b) Electrical connectors for making and breaking as many as 41 electrical circuits at one time are used in missile tracking equipment.
(c) Comparator chart in background enlarges connectors 10 times and checks the accuracy of all holes and insets.
(d) Pick-up head for stereophonic record player. This is a complicated but very small part (one third the width shown) in which three insets are molded into the head.

That's a strong statement but a very important one to remember in planning any type precision molding project. Haveg works with every known material to provide the most economical moldings . . . with properties necessary to meet the most rigid specifications.

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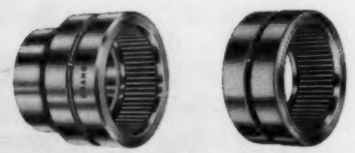
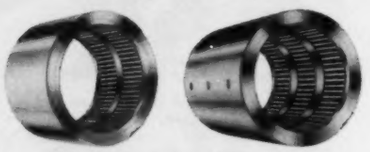


With or without inner race



Double and Triple Row Types for extra-heavy duty

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Longer, larger diameter rollers give increased capacity — yet interchangeable with standard needle bearings.

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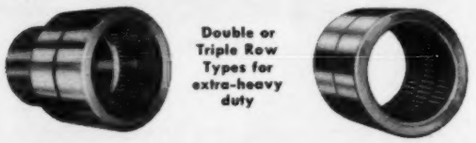
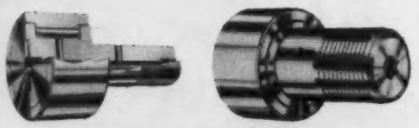
Heavier sectioned — larger rollers — higher capacity. Inch sizes between standard needle and cylindrical roller bearings.



Double or Triple Row Types for extra-heavy duty

ORANGE CAM FOLLOWERS



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SEEN AND HEARD

Saturn, Cryogenics and Honeysuckle-

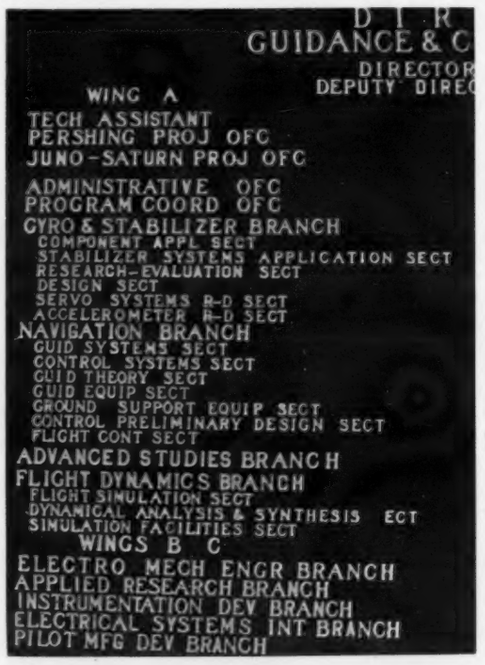
Victor W. Wigotsky, Eastern Editor

HUNTSVILLE, ALA.—The Saturn first-stage booster looks as much out-of-this-world as where it's going. It burns up the equivalent of seven railroad cars of liquid oxygen in two minutes to prove it.

Maybe you are already awed by the Saturn. If not, try to visit the George C. Marshall Space Flight Center in Huntsville, Ala. You'll see what I mean. The smell of honeysuckle will keep you firmly implanted in the present. It will help to keep you in some touch with the familiar when you step into the NASA facility and head for the Saturn booster's test firing stand. Then, when you look at the goliath pointed toward deep, deep space, maybe you won't have to pinch yourself.

It's not just that it's big. There is something mystical about it which almost gives it a life of its own. It seems to have a pulse that throbs and wants to get off the launching pad.

The occasion of my visit was to see something of the Space Flight Center and to attend the formal opening, by Linde Co., Div. of Union Carbide Corp., of the first major liquid oxygen and nitrogen plant to serve southern industry. The new low-pressure plant has a capacity of 140 tons a day; and, besides meeting the increased demands of the



steel, chemical, food and processing industries, it will conveniently feed the appetite of the Saturn.

This is a very large and voracious appetite. I looked into one of the high-strength aluminum liquid oxygen tanks being fabricated at NASA for the Saturn. It is 70 inches in diameter and 59 feet long. Tanks such as these will supply liquid oxygen as an oxidizing agent for the kerosene fuel in the cluster of eight Rocketdyne engines. These will ultimately provide the first-stage booster with a total thrust of 1,500,000 lb, or 32,000,000 hp. Static firings are now in progress in preparation for an initial test flight with inert upper stages from Cape Canaveral later this year and around the moon or toward nearby planets by 1964. A "space age barge", the Palaemon (named for a Greek sea-god), was built especially for transporting the Saturn's first and second stages the 2200 miles to Canaveral.

A simple bulletin board in the entrance of NASA's Guidance and Control Division reminds one that Saturn depends on more than sea-gods and muscle. The Space Age surely also means the Specialization Age, when one sees the many refined categories of engineering represented on this one board. Come up to the board and take your choice. If you just say you're a mechanical or electrical engineer you may get into the arena of space design, but getting a seat is another matter. "Servo systems engineer", "accelerometer engineer", "guidance control engineer" and so on are the tickets with seat numbers on them.

Leaving NASA to visit Linde's new liquid oxygen and nitrogen plant, one almost feels he is returning from the future after even a short exposure to the giant space vehicle. But the new plant in itself is an example of the accelerated pace of industrial growth of the South and an indication of things to come. Its location will eliminate transportation of liquid oxygen and nitrogen from distant points. Decentralization will thus be beneficial to producer and user.

Looking up at the Saturn one could almost think that the sudden firing of 32,000,000 hp for flight into deep space could disrupt the continuity between past, present and future too much for any bridge of intelligence to span. But when Saturn goes to visit the stars, carrying much of Earth's marrow and brain with it, it may find bridges we never dreamed of building.

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DESIGN SPECIAL REPORT NEWS

Lip Seal Failures—Cause and Prevention

Robert L. Dega, General Motors Research Laboratories, Warren, Mich.

Manufacturers have been making seals for years on the premise that "a good seal is a tight seal". Recent findings indicate, among other things, that tight seals fail prematurely; and that unless lip seals are built, checked and applied as precision assemblies, they will not perform properly. A 100 percent inspection of lip seals is necessary to eliminate potential leakers.

Just as in a journal bearing, an oil film must separate the contacting surfaces in a seal-shaft assembly for successful operation. However, even with an oil film and a perfect lip seal, leakage may develop if certain shaft characteristics such as surface roughness, machining lead, microscopic cracks, out-of-roundness and runout are excessive. Of course, being flexible, the lip will tolerate many shaft imperfections provided the shaft speed is not too high or the temperature so low as to stiffen the lip. For example, a good seal mounted on a shaft that runs slightly eccentric probably will not leak at low speeds, but might at higher speeds because of the likelihood of a standing gap forming between shaft and seal lip.

The same seal on the same shaft running true could also leak because of the minute helical surface grooves made during machining. These grooves may carry oil under the seal lip just as the flutes in a twist drill carry chips out of a hole. Also, the grooves may tend to abrade the lip. Reversing the direction of shaft rotation would stop all leakage from machining lead, but a controlled shaft surface finish represents a better all-around solution.

Leakage from Seal Installation

Another factor determining sealing effectiveness is the seal-to-shaft assembly operation. Numerous in-service leakages have been traced to this seemingly harmless act which often results in burrs, nicks and scratches to both the shaft and seal. Any attempt to correct seal leakage must automatically include greater quality control in assembly.

Main Difficulty: the Seal

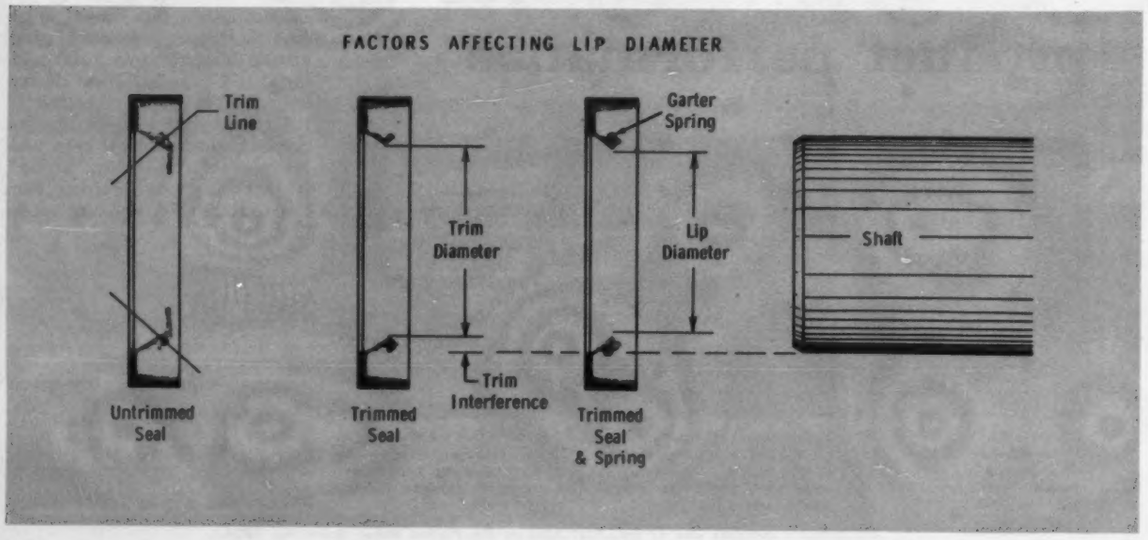
It has been established that seals leaked in service because of manufacturing tolerance excesses in the following lip variables: diameter, pressure, eccentricity and material quality. Actually, seals leaked because the necessary knowledge and inspection equipment did not exist to control these variables in production.

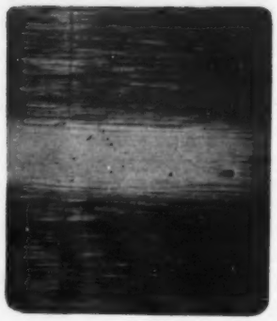
Lip diameter is determined by the trim diameter and the spring tension. Experiments with a series of seals having successively smaller lip diameters disclosed that decreasing the lip diameter increases the frictional drag on the shaft, despite the fact that the seals had identical lip-pressure settings at the start. The reason for this curious reaction stems from a property of the system known as stick-slip which causes the rubber compounds to shrink or tighten on the shaft because of twisting of the section. If the diameter is too small, the lip pressure is too high and stick-slip occurs at a high frequency, increasing the frictional drag and temperature and ultimately causing seal failure.

It also has been found that a pair of identical seals with different surface finishes may require different lip diameters. Laboratory measurements of a seal with a high trim interference and moderate lip pressure running on a smooth shaft with a 2-microinch surface finish revealed the seal to be in a state of lip flutter and high torque. Relocating the seal to a section of the shaft having a rougher finish of 10 microinches stopped both conditions immediately. The explanation lies in the fact that a shaft having too smooth a surface finish cannot support an oil film at high lip pressures.

Lip pressure is a combined function of trim interference, spring tension, rubber hardness and eccentricity. As might be suspected, raising the lip pressure increases temperature along with shaft torque and horsepower requirements. In a series of lip pressure tests on a seven-inch seal completely submerged in 160F oil, localized lip temperatures as high as 350F were reached—a completely unacceptable level for some seal materials. Yet production variations are such that seals made for the same application may have lip pressures high enough to generate such a temperature or low enough to render the seal ineffective.

Rubber hardness has been observed to





SLIGHT SCRATCHES AND AXIAL VOID IN SEAL PATH

MACHINING TOOL MARKS AND LEAD IN SEAL PATH AREAS

PITS OR VOIDS

10 MICROINCHES

vary as much as 20 points in some production seals limited by specifications to ± five points. It does not take much of a variation in hardness to exert a tremendous effect on temperature and seal operating characteristics. When the hardness is too low, the seal lip will have too wide a contact path, which permits a hydrodynamic film buildup, in addition to the fact that low hardness results in high friction. This means leakage because of the resultant greater running clearance formed. Conversely, high hardness prevents a wide enough contact path to sustain even a simple oil film; hence, eventual leakage because of material rubbing and high temperature occurs.

Corrosion by Lip Material

In connection with raw materials, a number of field failures has been related to corrosion pitting of shafts caused by some active agent in the seal. This is known to be the, most active at high humidities and corrosion will occur not only in new products in storage but in idle in-service products exposed to a highly humid atmosphere. Neutralizing greases have been recommended as a temporary measure to insure corrosion-free shelf life for new products; however, noncorrosive polymer should be developed to alleviate this undesirable and costly condition.

Quality Control the Answer

There is no doubt that lip seals can be improved or even that they can be made to operate like precision-fitted bearings. In fact, tests lasting more than 100 hr have demonstrated that maximum sealing is possible without shaft contact. Although, admittedly, laboratory tests represent the ultimate in controlled conditions, they nevertheless strongly indicate that better quality control by both seal manufacturers and seal users promises extended life of seals and leak-free performance of the products containing a seal. To repeat, a 100 percent inspection of lip seals is necessary to eliminate potential leakers.

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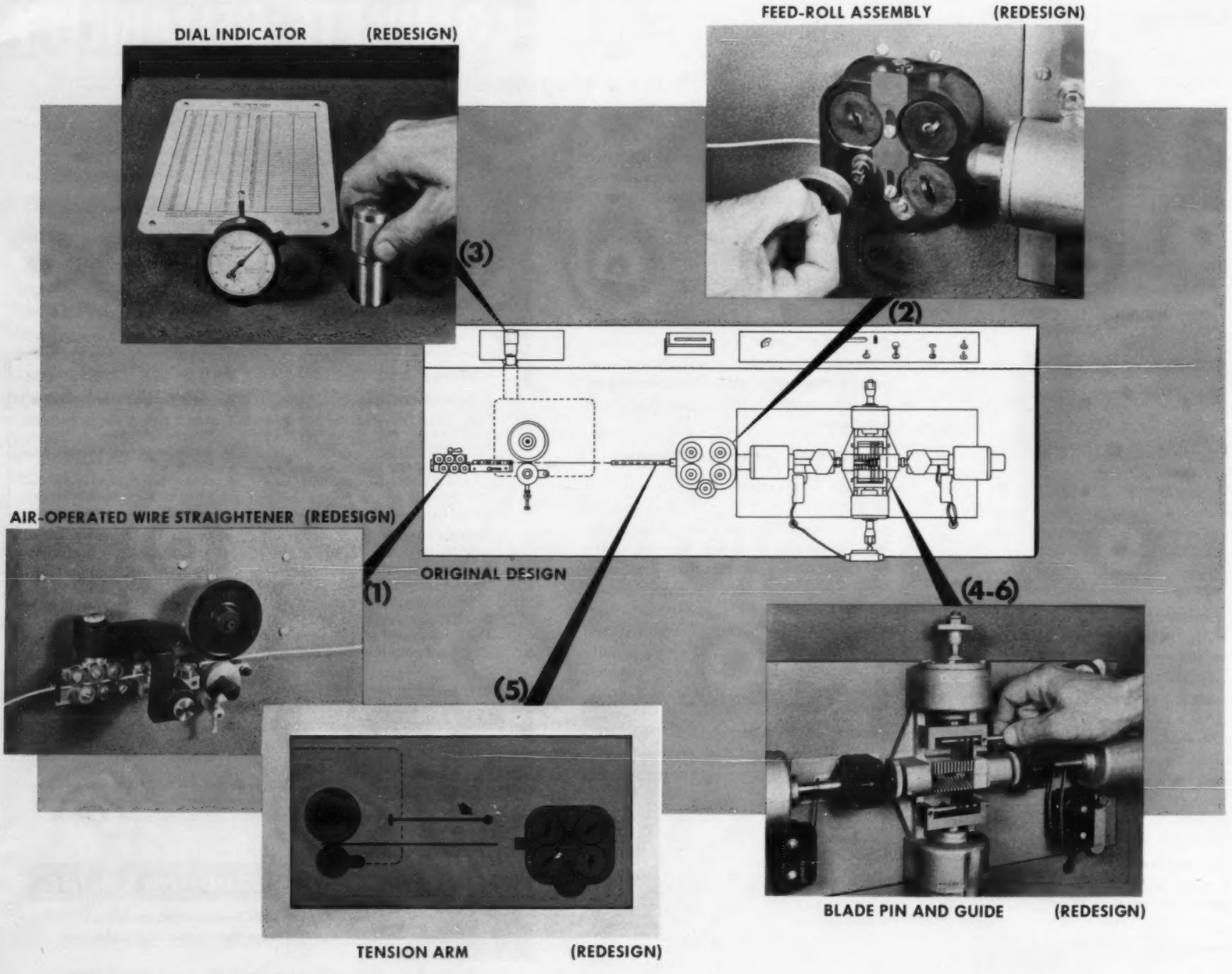
Redesign Eliminates Six Setup Tools

Edward W. Schrader, Western Editor



An automatic wire-stripping machine has been redesigned to make the device easier to set up. In the process of simplifying setup changes, the number of tools required was reduced from seven, including open-end wrenches, screw drivers, a magnet and Allen wrenches, to one screwdriver.

The reduction in tools needed saves operator time by eliminating the time it takes to find the required tool, pick it up, use it and put it down again. In addition, the hand operations are in every case quicker than the tool operations they replaced.

In this wire-stripping and cutting machine, wire travels through the machine at speeds up to 150 fpm. It will handle wire sizes from 12 to 26 gage and cut lengths from 1 to 600 inches, stripping both ends to the same or different lengths from 1/8 to 1 inch.

The Model 810A Automatic Wire Stripper is a design development of Eubanks Engineering Co., Pasadena, Calif.

♦

(1) AIR-OPERATED WIRE STRAIGHTENER closes straightening rolls to positive stops when air is turned on. Springs open rolls when air is turned off. Measuring wheel and idler are shown at right. Knurled knob replaces screwdriver head on idler tension adjustment which eliminates use of one small screwdriver.

(2) FEED-ROLL ASSEMBLY uses sliding lock and self-keyed feed rolls to replace screw and keyed washers. This eliminates a 5/32-inch Allen wrench previously used to loosen socket-head screws that held feed roll on shaft. Also magnet was used previously to remove feed rolls from shafts after screws and keyed washers were removed. Key built into each feed roll now serves both as means of securing roll to shaft and as handle for removing roll.

(3) DIAL INDICATOR on measuring device replaces micrometer, which was slower and more difficult to read. Indicator readings are taken from wire-length table.

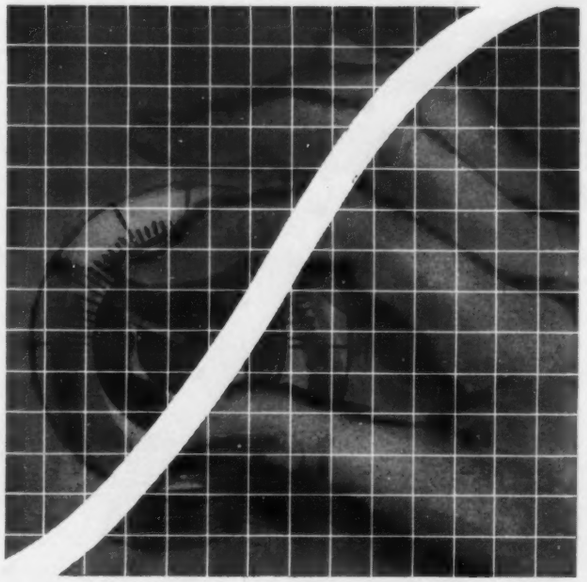
(4) BLADE PIN formerly held in place by set screw is now held by ball detent. Knurled discs replace hex guide bushings. This eliminates 3/8-inch oen-end wrench formerly used to adjust blade-depth micrometers and to remove and replace guide bushings, also 5/64-inch Allen wrench formerly used to loosen screw that held blade pin in place.

(5) TENSION ARM provides friction to prevent stiff wire from jumping forward against blade when clamp is released. Formerly two sizes of tubes were used to accommodate various wire sizes and provide this tension. This eliminates an adjustable crescent wrench used to change guide tube leading into feed rolls.

(6) GUIDES with ends slotted for lone remaining screwdriver required for setup. Screwdriver is inserted through right strip assembly and strip block to reach wire guide for adjustment. This eliminates 5/16-inch open-end wrench formerly used to change wire guide at right end of left strip assembly.

Warner electric brakes and clutches

with stepless torque modulation may be the answer to your drive problems

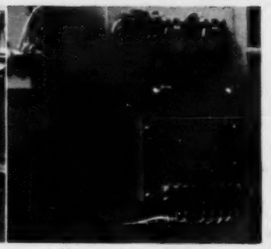


By simply varying the voltage to a Warner electric brake, clutch, or clutch-brake—you can have full-range stepless control flexibility. Just by turning a potentiometer dial on the Warner control, torque may be varied over a wide range during the first few seconds of engagement. Some companies offer adjustable torque as an extra feature for tailoring power characteristics to job requirements. Others have found it to be the solution to difficult control problems, such as synchronized engagement and disengagement of interrelated power drives.

Warner electric brakes and clutches are used for fast starting . . . synchronizing . . . automatic coupling . . . high-speed cycling . . . indexing . . . jogging . . . interlocking . . . and for scores of other power drive control applications. Write today—find out how they can solve your problems!

Primary clutches, clutch-brakes, brakes to 100 hp.

Warner Motor Brake



Warner Control Panel

example:

Two different braking torques from the same electric motor brake. When hoisting concrete blocks, not much braking torque is needed—yet when lowering pallets, a full braking action is necessary. Warner motor brake on this elevator drive may be actuated through either of two potentiometers. One is set at low voltage and the other at high voltage. Thus, two different braking torques are obtained by actuating the brake through relays, controlled by the *up* or *down* cycle of the elevator. Standard controls are used throughout.

WARNER ELECTRIC

Warner Electric Brake & Clutch Co., Beloit, Wisconsin

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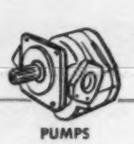
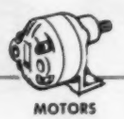

PUMPS

VALVES


MOTORS

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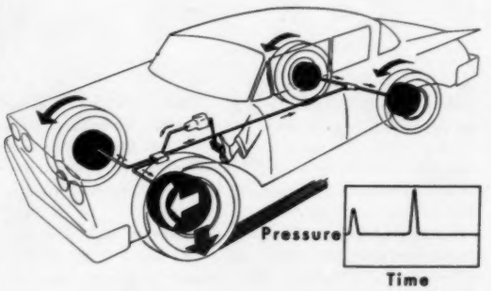
Air Chamber Compresses

Edward W. Schrader, Western Editor

A small, sealed air chamber compresses to absorb surge pressures in an automotive brake system. The chamber equalizes variations in back pressure resulting from unequal brake-shoe contact. It allows the friction pressure of the brake shoe against the drum to remain constant. Uniform coefficient of drum friction in each wheel during the cycle of rotation results in an even, controlled stopping action of the car.

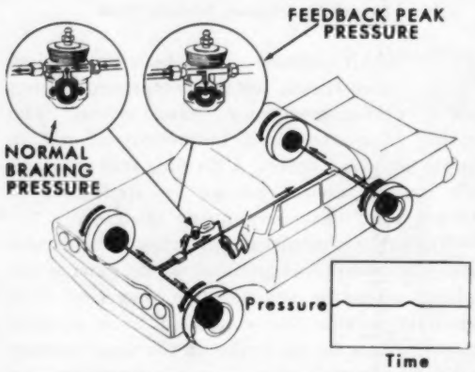
A recent State Highway Patrol test demonstrated that a car traveling at a speed of 90 mph could make a straight skid, full stop in 100 ft. At 70 mph, the normally accepted stopping distance is 220 ft.

The brake equalizer is a design development of Do-Mor Brake Engineering Co., Orange, Calif.



UNCONTROLLED SKID results when one wheel is locked while others are still turning. Locked wheel acts as fulcrum and car pivots or swerves about locked wheel. As long as brake pedal is held down, hydraulic fluid in lines and cylinders does not change in volume. Pressure, however, rises and falls in proportion to individual wheel-cylinder feedback. Momentary peak-pressure surges may result from heating, high spots on brake-drum surfaces and other irregularities between shoe and drum.

to Equalize Braking Force



CHAMBER completely seals and isolates air from hydraulic system. Small amount of air (approximately ⅛-inch-dia sphere) compresses under surge pressures. Action of chamber should not be confused with air bubbles in brake system. Brake system always must be bled to eliminate mushy brakes, whereas air chamber in system gives about ⅛-inch pedal softness, which allows driver to control car.

BRAKE EQUALIZER may be inserted into hydraulic-brake system at any point between master cylinder and wheel cylinders. Fitting on top of unit is for bleeding air from brake lines.

Johnson & Hoffman broadens its range

Deep-drawn parts
Up to 8 in. dia. and 4 in. deep, in material up to 1/16 in. thick.

Multi-slide parts
Wire .005 to .188 in. dia.; Strip .005 to .031 in. thick, and up to 2 in. wide.

Stampings
Up to 12 in. wide, in material up to ¼ in. thick.

Now from this one source, you can get stampings, deep-drawn parts, and multi-slide parts in a wider range of sizes than ever—but with the same close tolerances, choice of materials, and low prices. J&H has expanded its facilities by purchasing the Stamping Division of the Fred Goat Co., Inc., Brooklyn, N.Y. For a quotation on a part you need right now, simply send a drawing.

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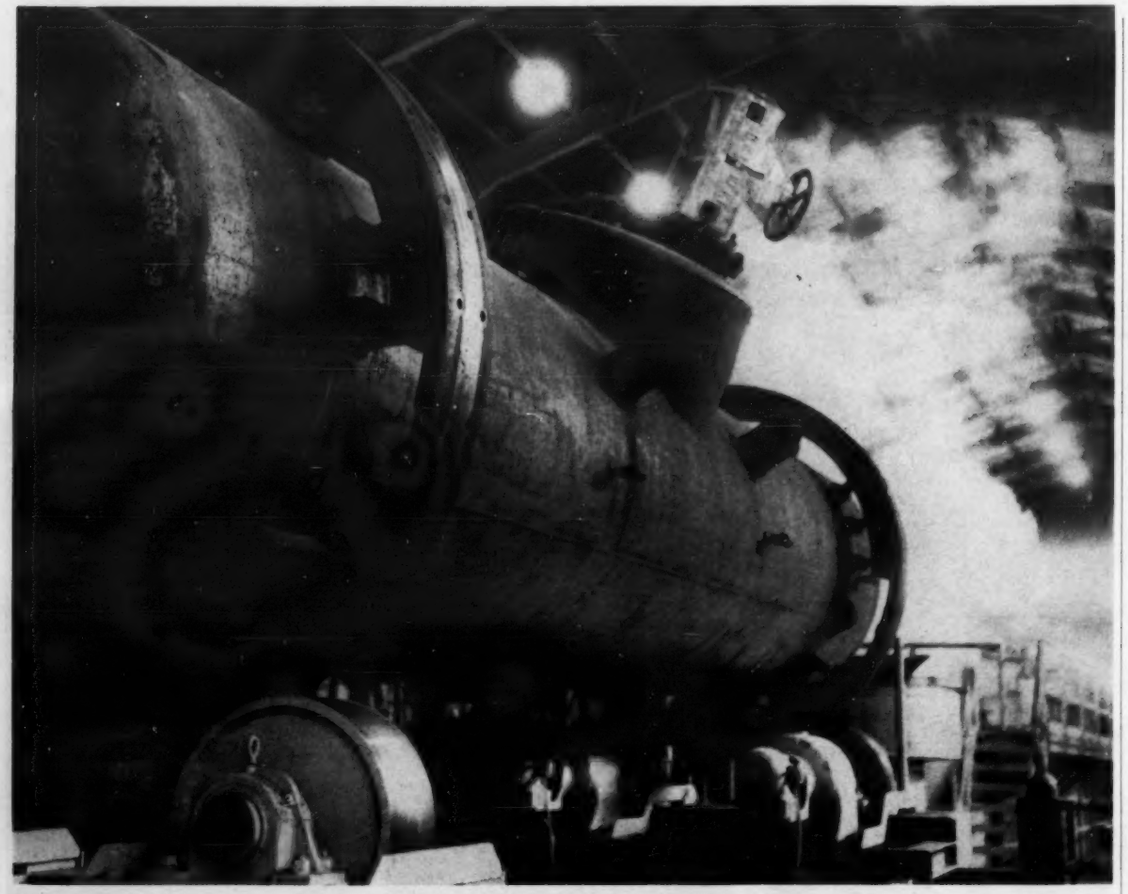

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Only General American and its authorized licensees around the world can show you how Kanigen coating may improve your product. The Kanigen process is protected by more than 30 separate patents. For detailed technical literature, write for bulletin No. 561.

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GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South LaSalle Street, Chicago 3, Illinois *Offices in principal cities*

Circle 12 on Reader-Service Card for more information

Compression Springs

Edward W. Schrader, Western Editor

Failure of air pressure caused by a broken line or any other reason releases compressed springs in a parking-emergency brake system. The spring force extends a button-covered rod to apply the wheel brakes. A dividing wall separates the normal service chamber for application of brakes from the safety spring chamber.

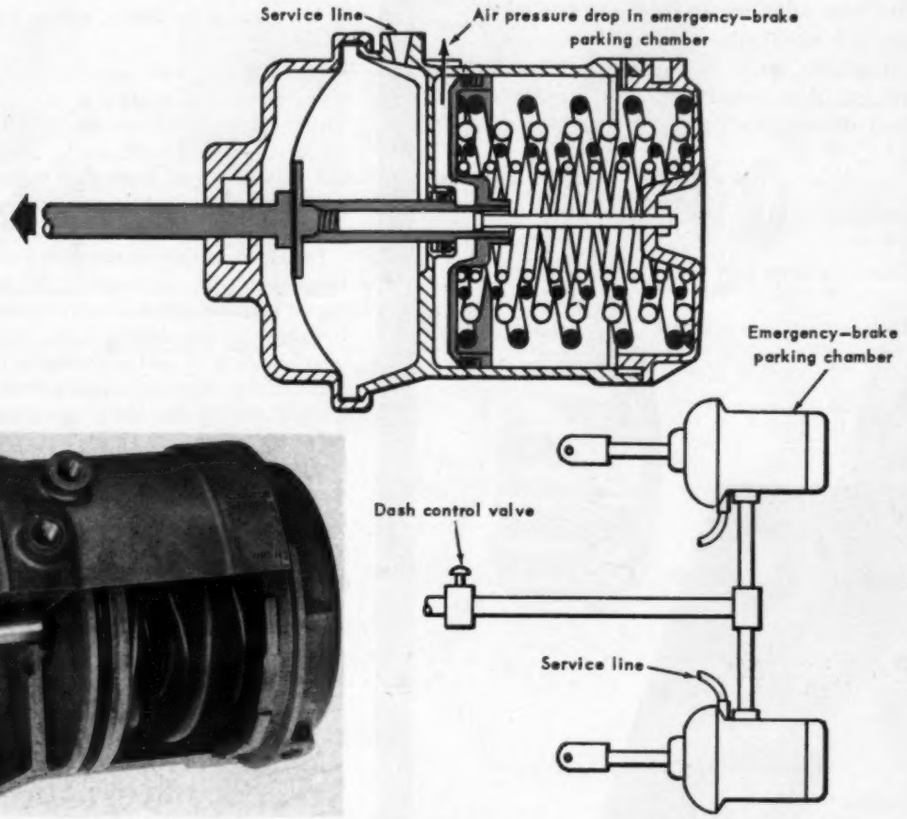
Normal system air pressure from the service reservoir compresses the springs by moving the piston when the vehicle is in operation. The air-brake service line connected to a separate port operates the air brakes in the usual manner upon application of air to this chamber.

The emergency braking system operates the standard service brakes. It is adjusted automatically each time the service brakes are adjusted. The summation of four spring forces gives a linear rate so the device will operate automatically in proportion to air-pressure loss. It starts the braking action when air pressure drops below 55 psi. Use of multiple springs gives a compact size without overstressing the material of the individual springs to obtain the maximum applied force. Standard models supply 1100 1500 lb of braking force per wheel over the normal brake adjustment range.

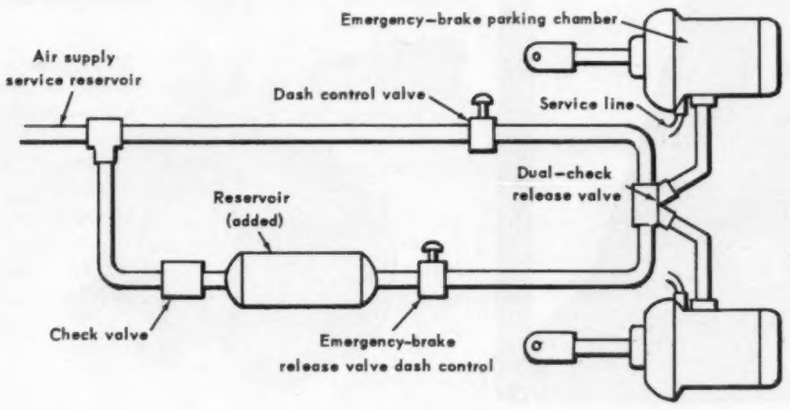
The Hytrol parking-emergency brake system is a design development of Hydro-Aire Co., a Div. of Crane Co., Burbank, Calif.

AIR-SPRING CHAMBER replaces pressure plate on standard service brake chamber. System is designed to meet ICC regulations and new California State Law which requires automatic braking system on truck-tractor rigs if air supply to service brakes fails.

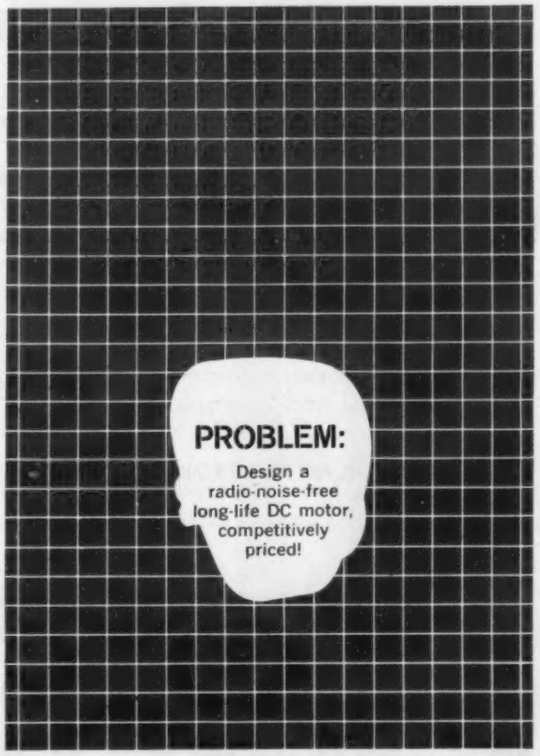
Automatically Apply Brakes when Air Pressure Fails



BRAKE SYSTEM may be used for both parking and emergency stops. Brakes may be released after emergency stop by application of air pressure from hand pump or one of dual tires through tank valve inserted in line.



SEPARATE SELF-CONTAINED AIR SUPPLY in system permits release of emergency brakes from truck cab by brake-release valve on dash. This arrangement is particularly suited for use in school buses with women drivers.



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*Determined by AFBMA formula

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Vent Relieves Pressure

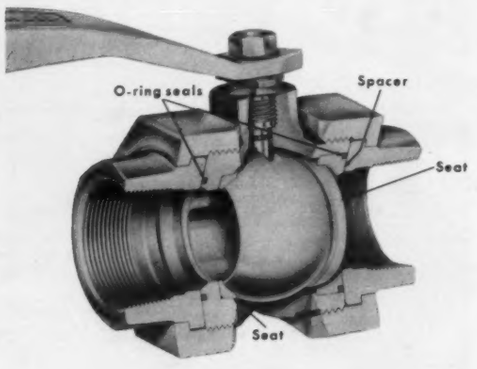
Lars G. Soderholm, Midwest Editor

A dual-seat ball valve uses seats designed to vent when pressure is applied at the upstream side. This balances forces on the upstream seat and reduces frictional resistance to that required to seal only one seat. Resistance is low enough to permit the valve to be turned easily under pressure.

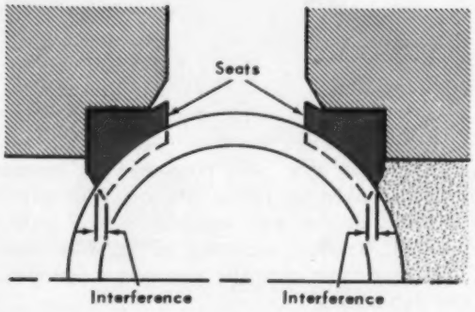
Improved sealing characteristics and simplified installation and maintenance features were designed into the new ball valve. Improved sealing is gained by the design of the valve seats. An interference fit is used so the ball is made to float between the seats. This interference fit provides a tight seal at low fluid pressures. At higher pressures the ball is forced against the downstream seat, deforming it slightly to make a greater sealing area. The fluid, in the meantime, is permitted to leak around the upstream seat, equalizing the pressure on it. This reduces friction on the ball so the valve can be turned easily.

The one-piece, forged valve body attaches directly to union ends. Ends can be screwed or welded to a pipe and the valve body is placed between them. It is attached by tightening the union nuts. Union ends can accommodate considerable pipe misalignment.

Valve seats are held at one end of the valve by the forged valve body (indicated by a dimple in the casting at the stem) and at the other end of the valve by a spacer ring. If the solid valve body end of the valve is downstream, the union end and piping below the valve can be disassembled while the valve is closed against pressure.

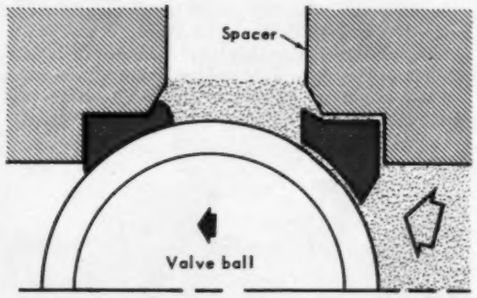


on Seat of Ball Valve



LOW TO 0 PRESSURE CONDITIONS

Interference fit maintains seal

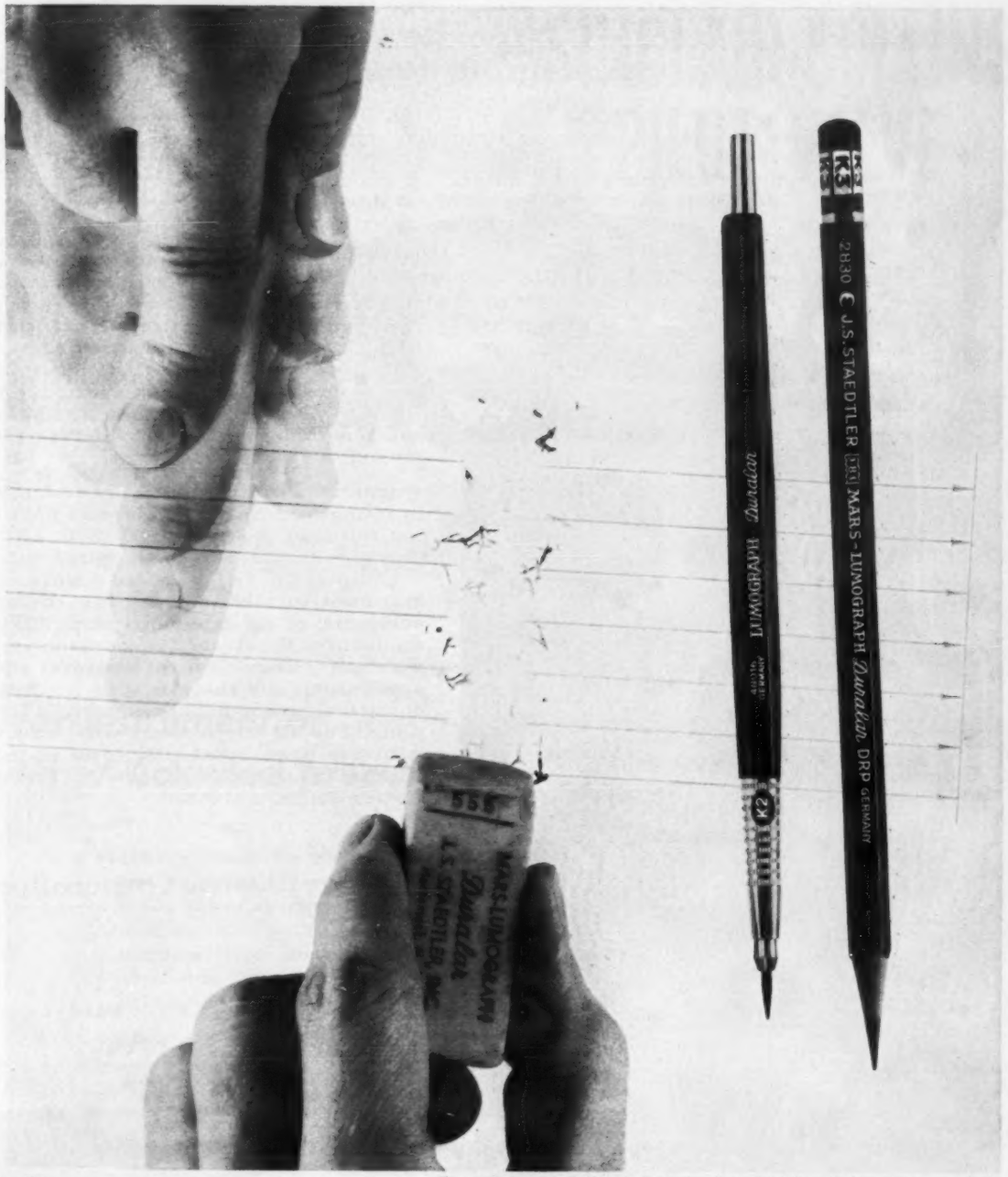


HIGH-PRESSURE CONDITIONS

Design venting relieves pressure on upstream seat so valve can turn easily

Valve bodies, stems, balls and union ends are available in carbon steel, Type 316 stainless steel and brass. The ball is hard chrome plated in the steel and brass valves. Valve seats are available in "Teflon", "Buna-N" or neoprene and the valve seals are also available in similar materials. The valve is made in ¼- through 2-inch sizes for vacuum service and for pressures up to 1000 psi (with "Teflon" seats).

The Petro Ball Valve is distributed by Clayton Mark & Co., Evanston, Ill.



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Wagner® "Stand-up" motors pack plenty of power

Here's plenty of power for equipment requiring normal thrust vertically mounted motors. Wagner® Vertical Solid Shaft Motors provide power without problems for your pumps, mixers, agitators, axial fans, centrifuges, presses . . . anywhere you need a vertical motor drive with plenty of stamina.

Wagner Vertical Solid Shaft Motors are end-mounted, squirrel-cage type with a NEMA Type "P" base that is precision-machined to mate with equipment. Smooth running under cyclic loads, they won't labor or stall . . . conform with NEMA Design B motor requirements in all respects. Their cast iron construction is simple and rugged . . . stands off corrosion . . . stands up to rough, tough treatment. Here are motors that are designed to give you economical, maintenance-free service the year 'round, indoors or out.

Wagner "Stand-up" Motors are available in ratings of 1 hp and larger with nominal full load speeds of 3500, 1750, 1160, or 870 rpm, and can be supplied with a completely dripproof enclosure, a standard totally enclosed fan-cooled enclosure, or an explosion-proof TEFC enclosure. Whatever the horsepower, whatever the enclosure, whatever the application, one thing is sure . . . these compact, power packages get the job done. For all the reasons why, check with the Wagner Sales Engineer in the Wagner branch nearest you, or write us for Bulletin MU-249.

WM61-8

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Wagner Vertical Solid Shaft Motors provide the power for Smith & Loveless sewage pumping stations.

Circle 16 on Reader-Service Card for more information

Plastic Bushings Provide

Robert L. Candlish, Detroit Editor

"Teflon" bushings, used extensively in the chassis of a new family of medium-duty tactical vehicles, avoid frequent lubrication and inspection operations in service. The vehicle was designed to operate in difficult terrain, in deep sand, mud or snow and was also to be floatable in water and to be overhaul-free for 20,000 miles. To accomplish this the axles were positioned and torque reactions taken by radius rods and the spring shackles and pins were replaced by wear plates. "Teflon" bushings were used in the radius rods to replace those normally requiring supplementary lubrication.

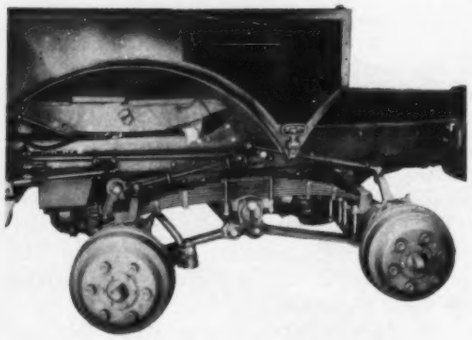
The tactical vehicle chassis was designed by the G.M.C. Truck & Coach Div., Pontiac, Mich.

RADIUS ARMS locate axles, absorb driving and braking torque reactions. Radius arms steering tie rods are fitted with "Teflon" bushings and require no lubrication. Spring pins and shackles are eliminated. Ends of semi-elliptic springs float free on nonlubricated, cam-shaped replaceable brackets or wear plates. Spring brackets, wear plates and torque rods are interchangeable in all positions on both 6x6 and 8x8.

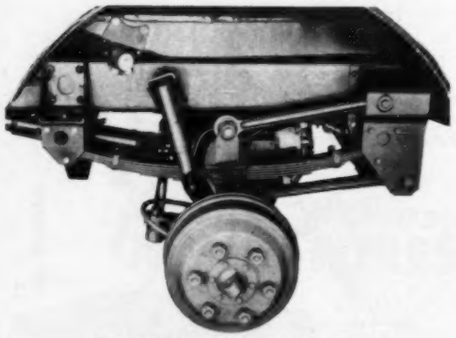
TACTICAL VEHICLE with all wheels powered has high mobility under military conditions.

"TEFLON" BUSHINGS requiring no lubrication are used on spring hanger trunnion and ball connection of radius rod. Spring wear plates or brackets replace normal shackle and effectively shorten sping length with deflection, providing a variable rate spring. Wear plates are malleable iron, flame hardened on wear surface, and work directly against steel spring end.

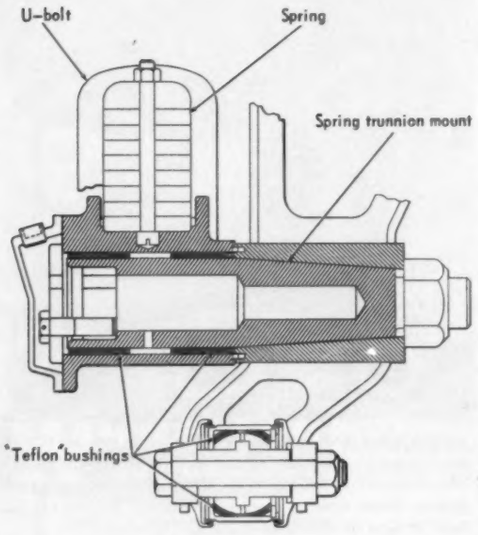
10,000-Mile Service-Free Suspension



FRONT SUSPENSION - 8x8 LEFT FRONT

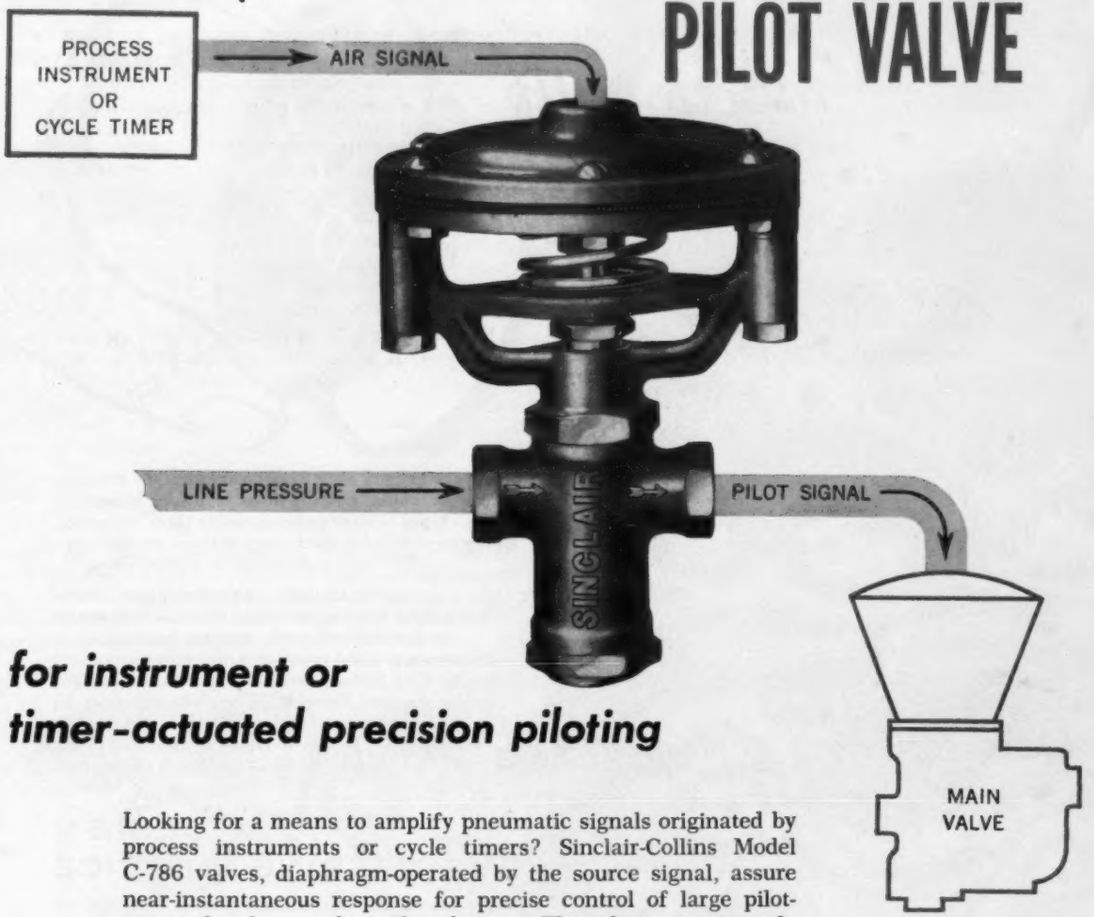


FRONT SUSPENSION - 6x6 RIGHT FRONT



8189

Compact, low-cost SINCLAIR-COLLINS PILOT VALVE



for instrument or timer-actuated precision piloting

Looking for a means to amplify pneumatic signals originated by process instruments or cycle timers? Sinclair-Collins Model C-786 valves, diaphragm-operated by the source signal, assure near-instantaneous response for precise control of large pilot-operated valves and similar devices. They feature extremely short stem travel, from closed to fully open, and a flow area equal to ¼ in. standard pipe.

Space a problem? The Model C-786 measures but 5⅜ in. high . . . is only 3⅞ in. in diameter. Cost a problem? You'll find this valve, with all the built-in quality features found in every S-C valve, priced attractively.

Models for air, steam, hot or cold water, or inert gas service; bronze, ductile iron or stainless steel bodies; 2 or 3-way; 20 to 50 psi signal, 125 psi main valve; tapped ¼ in. NPT. Ask your nearby Sinclair-Collins Field Engineer to show you how the Model C-786 fits your instrumentation control system.

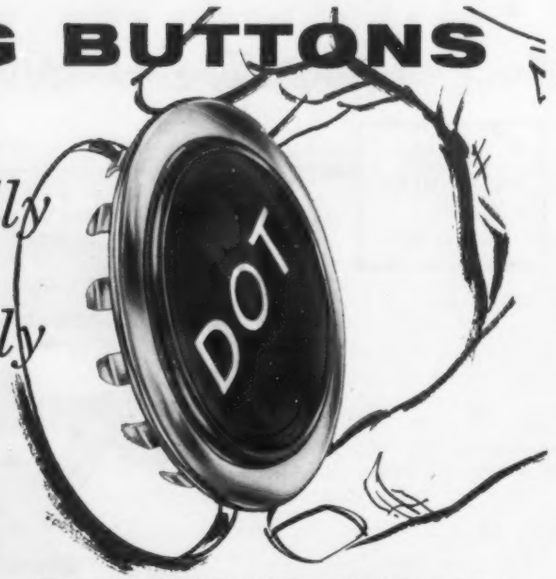
The SINCLAIR-COLLINS VALVE Co.
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)
AKRON 11, OHIO

For more information, write for Bulletin 59-SC. Address The Sinclair-Collins Valve Company, Akron 11, Ohio, Dept. DN-661.

Circle 17 on Reader-Service Card for more information

DOT PLUG BUTTONS

fill holes functionally and decoratively



Inexpensive DOT Plug Buttons are ideal for covering drilled or molded holes in metal or plastic structures of all types. Finger pressure snaps them into place, spring tension holds them there without rattling even under conditions of severe vibration.

Used as covers for inspection or maintenance-access holes, Plug Buttons are easily removed and can be re-inserted repeatedly without lessening their effectiveness. Used in combination with plastic lens inserts, Plug Buttons make excellent indicator-light covers. Faceted, Fresnel-type or plain lenses can be made in a variety of colors and can be designed to show words, letters or symbols, according to the requirements of the particular application.

DESIGN ENGINEERING SERVICE

Designers, metallurgists and plastics specialists on DOT's engineering staff are equipped to work out optimum combinations of metal and plastics to suit your particular requirements. Hundreds of variations in shape, finish and material are possible.

The basic steel or brass Plug Button, for example, can be parkerized or polished or finished in chrome, nickel, zinc, copper or any of a wide variety of colored enamels. Designs can be stamped into the metal or molded Lucite lenses can be inserted.

Nylon, polystyrene or flexible polyethylene Plug Buttons can be molded to show trademarks, indicator symbols or any other design.

For further details write for Engineering Data Catalog, Section D

MAKERS OF ★ DOT ★ FASTENERS

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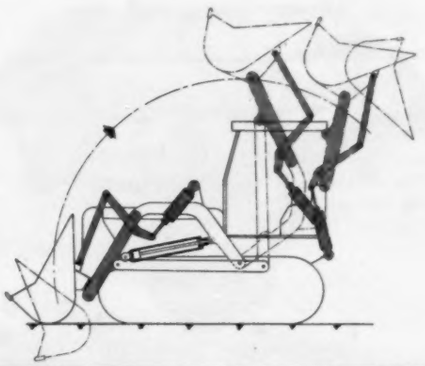
Linked Torsion Bars

Celestino O. Lubatti, Italian Editor

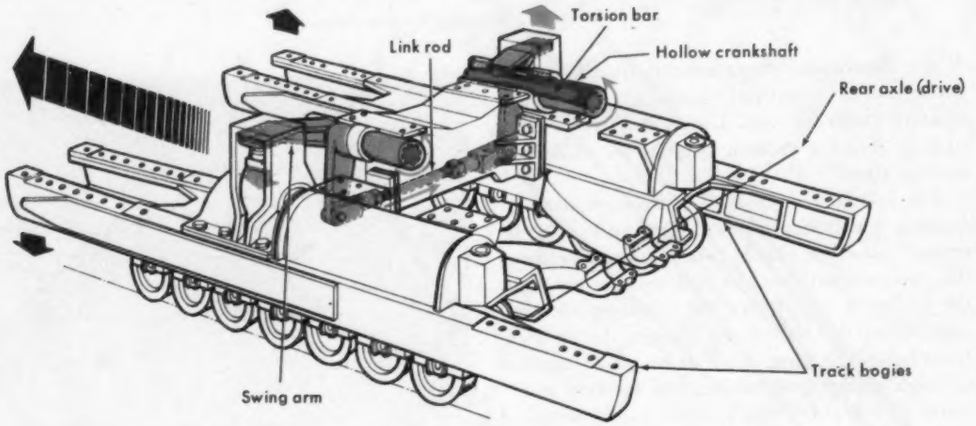
Interconnected torsion bars absorb high-frequency vibrations and reverse the main shock forces applied to power-shovel track bogies by ground bumps. When uneven ground swings up one bogie about the rear axle, the reversed force presses down the other to maintain adherence of both tracks over the deviating planes. The torsion bar linkage eliminates leaf and/or coil springs, permits sturdy construction throughout the track suspension.

The development is by Ing. Pietro Pensa of Allis-Chalmers Italiana SpA, Milan, Italy.



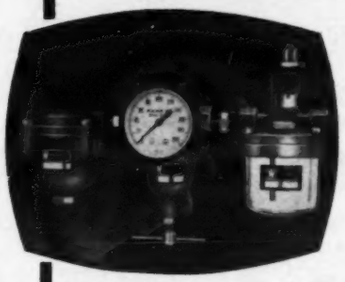
TRACKED TRACTOR is powered by D-150 Allis-Chalmers diesel engine developing 70 hp. Hydraulic shovel takes material on front and dumps it back into loader (not shown). Other types of loading or digging buckets can be used. Weight of vehicle is 11,750 kg (13 tons).

Damp out Opposed Oscillation of Track Bogies



HOLLOW CRANKSHAFT on vehicle frame houses and engages splined end of torsion bar. Crankshaft is keyed to swing arm sensing track bogie oscillation. Equal torsion-bar assembly on other side responds to main shock forces and acts against bogie in opposite direction. Adjustable link rod connects crank arms, imparts initial load to torsion bars for proper suspension response.

Low-cost... **Wilkerson MINIATURES...**



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The first American Astronaut in Space will rely on a continuous supply of oxygen metered through intricate valving which has been designed by Garrett Corporation, AiResearch Manufacturing Division, engineers with the technical assistance of Stillman Rubber Company experts.

To produce a reliable poppet in sub-miniature size which would meet micro-precision requirements, Stillman Laboratories developed a special compound designed especially for NASA's Project Mercury. This compound, TH-1080, was bonded under critical conditions to the stainless steel body and shaft, and the poppet then ground to precision tolerances.

By close coordination with Garrett engineers, Stillman technicians were able to produce this precision part in only four days from the design release date. Stillman's reputation for quality and reliability in the aircraft and missile industry, together with years of technical experience and know-how, enabled them to produce and deliver the all-new, sub-miniature poppet in record time. These same qualities of experience and technical abilities are available to any industry or manufacturer who specifies the finest static and dynamic sealing.

For further information, write to:
STILLMAN RUBBER COMPANY
5811 Marilyn Avenue / Culver City, California

Circle 20 on Reader-Service Card for more information

Circle 21 on Reader-Service Card for more information

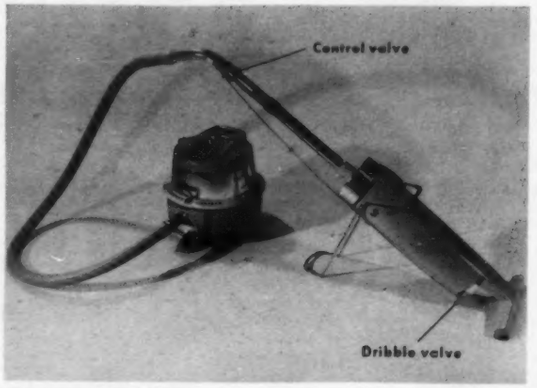
Exhaust from Vacuum Cleaner

Victor W. Wigotsky, Eastern Editor

A new floor washer-dryer attachment uses the exhaust end of a vacuum cleaner to eliminate a separate motor-fan unit. Use of the ejector principle to create a vacuum requires no additional moving parts.

The accessory consists of a two-compartment housing which separates the dirty and clean detergent water. An ejector tube is formed between the two compartments to feed exhaust air from the cleaner to the floor. The resulting vacuum, induced in the top of the housing by air ejection, causes the dirty water to be forced upward through a floor-level nozzle. The ejection of exhaust air is regulated by a simple hand-controlled slide valve, through which air is either vented or directed down the tube.

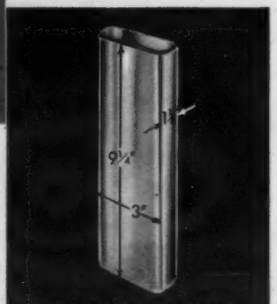
The Model SC-1 floor washer-dryer is a product of the Vacuum Cleaner Dept., General Electric Co., with headquarters in Bridgeport, Conn.



No Tooling Cost To Draw Shapes Like These and dozens of others with POLAR WARE Facilities

Seamless drawn cylindrical container of 22 gauge steel.

Seamless drawn rectangular container of 20 gauge, type 302 stainless steel.



Seamless drawn oval container of 20 gauge, type 302 stainless steel.

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Polar Ware Co.
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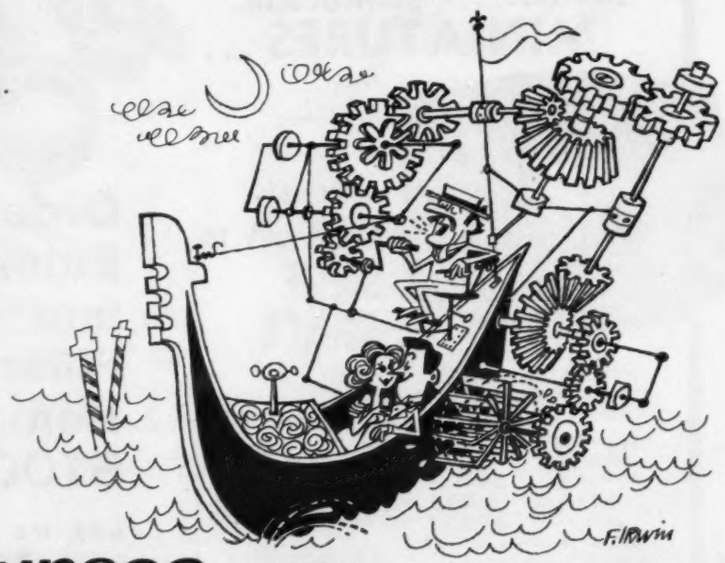
If you're looking for prototype precision in quantity production with immediate delivery schedules, you just can't beat DYNACO Precision Stock Gears and Assemblies engineered to answer every conceivable transmission requirement.

More than 50,000 different off-the-shelf gears and components are listed in Dynamic's Catalog F-128. Send for your copy today.



Dynaco GEARS
a product of
DYNAMIC GEAR COMPANY, Inc.
175 Dixon Avenue • Amityville, Long Island, N. Y.
Telephone: AMityville 4-4788 • Teletype: Amityville, N. Y. 640-U
Western Division: 8912 Sepulveda Blvd., Van Nuys, California
P.O. Box 4156 • Telephone: EMpire 2-3125 • Teletype: SNFD-4436

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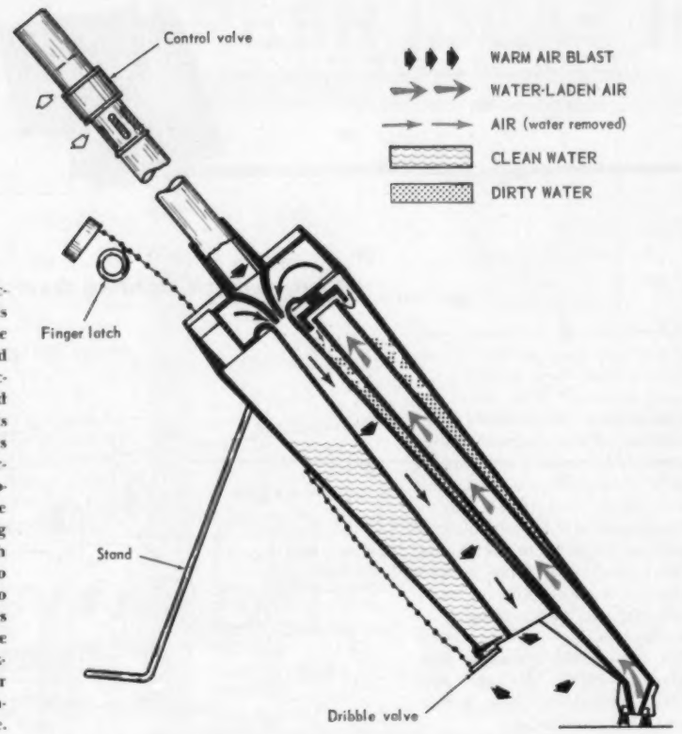
Powers Accessory

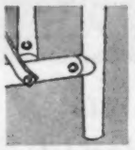


ACCESSORY requires no additional electrical elements. Clean detergent water is dispensed to floor through dribble valve which is held closed by spring and opened through bead-chain and ring linkage. Ejector nozzle and vacuum chamber are located in top of housing. Control valve connects unit to cleaner through hose and includes simple slide-regulating valve. Clean detergent water is then dispensed to floor by operating dribble valve with control valve open. Ejector system is operated by closing slide valve following scrubbing of floor with brushes in nozzle. Exhaust air directed to floor causes dirty water to be vacuumed into chamber. Unit weighs 7 lb and operates with General Electric canister cleaner. One injection-molded part provides ejector exhaust tube and both clean and dirty water compartments. Combination stand and handle is made from chrome-plated steel wire.

Use it for laminating... SEL-LOK spring pin

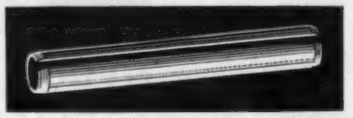
Tool handle

Lifts for women's shoes


Metal table legs

- Swift fastening—just drill and drive
- Secure locking—won't work loose despite shock or vibration
- Eliminates costly tapping, reaming, peening, milling
- Can be reused repeatedly
- 101 uses—as keys, cotter pins, axles, hinge pins, wrist pins, stop pins, pivots, etc.

SEL-LOK spring pins are available in carbon and corrosion-resistant steel (from 1/16 x 3/16 through 1/2 x 4 in.) and beryllium copper (1/16 x 3/16 through 1/4 x 3 1/2 in.). See your SPS distributor or write for Bulletin 2670.



INDUSTRIAL FASTENER Division SPS

JENKINTOWN 6, PENNSYLVANIA

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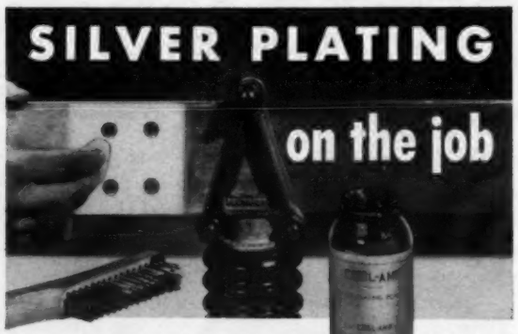
SILVER PLATING on the job



EASILY APPLIED

Cool-Amp can be applied on the job. The only equipment needed is a clean rag, a wire brush and some water. Cool-Amp contains no cyanide and can be used in underground vaults, substations and hard to get at places by several persons at the same time.

REDUCES RESISTANCE

Cool-Amp Powder deposits a genuine coat of silver that will not peel off. It prevents oxidation, minimizes overheating, thereby reducing maintenance. Provides cool maximum conductivity for all copper, brass or bronze current-carrying connections.

FREE SAMPLE—Write today for informative folder and free sample of Cool-Amp. One pound will silver plate approximately 6,000 square inches. $13.50 per pound—Shipped prepaid.

The COOL-AMP Co.

Dept. DN, 8603 S. W. 17th Avenue, Portland 19, Oregon

Circle 24 on Reader-Service Card for more information

"Dyflon"® Self-Aligning and Self-Lubricating SPHERICAL BEARINGS

Combine "Monoball"® Engineering Advantages with Life-Time Lubrication

Design engineers in many industries are specifying new "DYFLON"® SELF-ALIGNING and SELF-LUBRICATING SPHERICAL BEARINGS for these 5 major reasons:

1. **LOWER COEFFICIENT OF FRICTION** ...ideal where lubrication is impossible or undesirable.
2. **WITHSTAND EXTREME VIBRATION** ...perfect performance under shock load conditions.
3. **WILL NOT "COLD-FLOW"** ...even under extreme load conditions.
4. **IMPERVIOUS TO KNOWN CHEMICAL SOLVENTS** ...eliminates corrosion problems.
5. **FAIL-SAFE** ...due to "Monoball"® design.

Request Engineering manual No. 551.

In addition, due to their two-piece "MONOBALL"® design and plastic alloy insert, "DYFLON"® bearings have a long cycle life. Alignment and installation problems are minimized. Oil-free for life means lowest possible maintenance costs.

Available in a variety of plain or rod end types. Bore sizes to 3.000". Materials include stainless steel, plastic alloys and chrome alloy steels. Ultimate static loads to 500,000 lbs.

SOUTHWEST PRODUCTS CO. 1705 SO. MOUNTAIN AVE. MONROVIA, CALIF. · PHONE: MURRAY 1-9616

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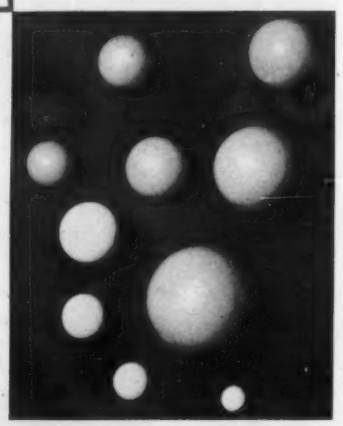
CLEAN
CLEAR
and
CORROSION-PROOF



NYLON AND TEFLON BALLS

Thanks to special grinding and finishing methods, ITI Nylon and Teflon® balls are FREE OF EMBEDDED SURFACE GRIT. Their clean, clear finish assures THE BEST in reliability for your products.

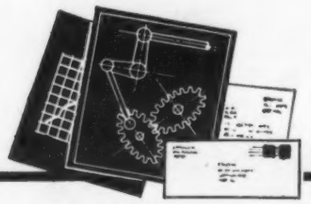
Nylon balls (Zytel® "101") are strong, lightweight and practically inert to most chemicals. Teflon balls have high lubricity and are completely inert to nearly everything. Both are available from stock—Nylon in 15 sizes, 1/32" to 3/4", and Teflon in 8 sizes, 1/32" to 1/2". Both are also made to order in any other size desired. WRITE for prices and samples (free on letterhead request).

iTi

We also make precision balls of *all other* workable materials, including stainless steels, carbides and special alloys—*all sizes*, standard and special—modified balls—hollow and plated balls—in experimental and mass-production quantities. BULLETIN BU-1 gives details; includes specs on stock balls of 8 materials. Want it? Write, phone or send the inquiry card.

INDUSTRIAL TECTONICS, INC.
manufacturers of precision balls and bearings
BALL DIVISION | 3686 JACKSON RD., ANN ARBOR 1, MICHIGAN

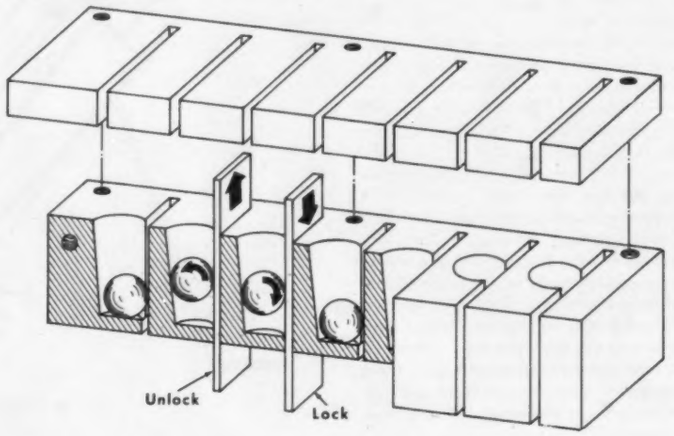
IDEA MART
DESIGN NEWS



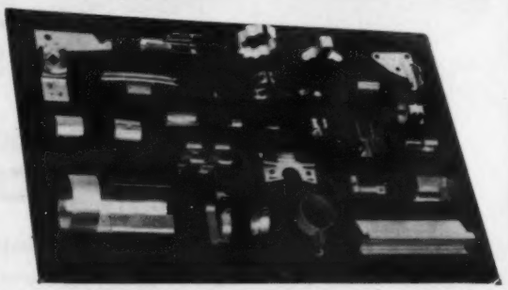
AVAILABLE

Positive-Lock Holding Device

Spheres moving in tapered raceways apply force against flat objects to lock them securely. Upward movement of the object permits removal. Applications of the holding device include knives, saws and various woodworking tools, drawing instruments, rules and curves. The spheres may be constructed of almost any material and can be suited to the application. The holder may be constructed of plastic, wood or metal, and may selected according to the application. Would like to establish contact with a possible manufacturer. Write IM 515, Idea Mart, DESIGN NEWS, 3375 S. Bannock, Englewood, Colo.



New Federal Combin-O-Tool Method SAVES UP TO 46% ON SHORT RUN STAMPINGS



Some typical parts produced by Federal Combin-O-Tool Method.

Combined operations mean lower cost short run stampings whenever they can be produced by the Federal Combin-O-Tool Method.
Where it formerly took 4 or 5 operations—it can now be done by Federal with only 2 or 3 operations. The labor savings are passed on to you in lower cost stampings.
Send your prints or parts today to see if they can be done with the new Federal Combin-O-Tool Method. The savings will please you.

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DEPENDABILITY

THESE HANDS ATTUNED TO QUALITY. The best raw materials . . . machined with modern tools, in the end, rely on the skilled hands of the machinist to turn out reliable hydraulic cylinders. CROSS craftsmen's skill has been forged by years of experience, tempered by the discipline of rigid, station-by-station inspection.

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CROSS Engineers Available to You for Free Consultation!

C 5-161

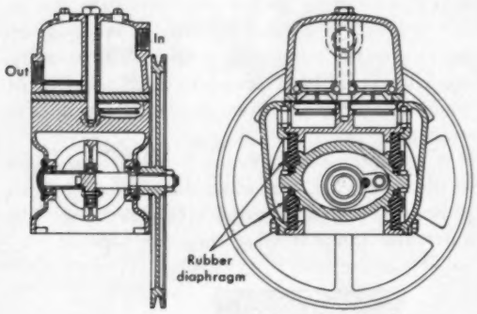
Ideas described in this department are in various stages of development and may be at any point from "initial concept" to "patented".

AVAILABLE

Pump

This pump is designed for water well service with 28-ft lift and a service pressure head of 60 psig. Two molded rubber or neoprene diaphragms are connected to a yoke and installed under radial compression of 1/32 inch to each inch of diameter. This installation relieves the rubber fibers and makes a 70 durometer diaphragm flex easily. The diaphragms have been tested thoroughly for long wear life. The pump is lubricated for life and will pump as much as 40 percent sand without component injury. Operation is quieter than the electric motor which operates it. An 11/24-hp motor will deliver 400 gpm to 40 psi.

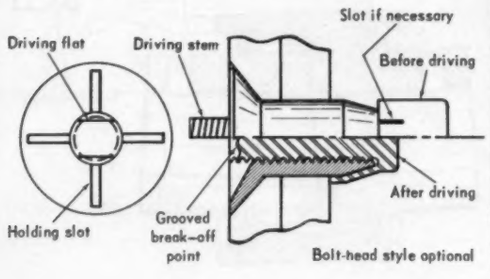
A manufacturer is desired for this and a line of similar abrasiveproof pumps up to 50 gpm. Write IM 513, Idea Mart, DESIGN NEWS, 3375 S. Bannock, Englewood, Colo.



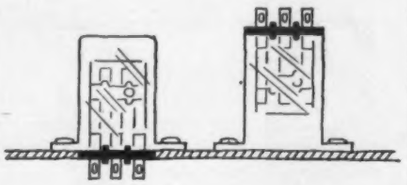
AVAILABLE

Two-Piece Blind Fastener

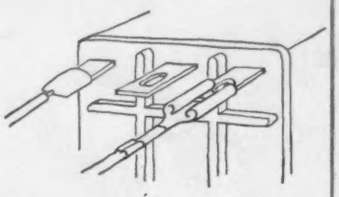
This preassembled fastener of molded or machined nylon is inserted in a prepared hole of the material to be fastened. A hand or power tool engages holding slots in the outer member, and a second tool grips and turns the driving stem. As the stem turns on its screw threads, the inner collar is expanded over a tapered shank on the outer member, drawing the material together. As high friction develops, the driving stem breaks off at a groove. Wish to sell or license. Write IM 514, Idea Mart, DESIGN NEWS, 3375 S. Bannock, Englewood, Colo.



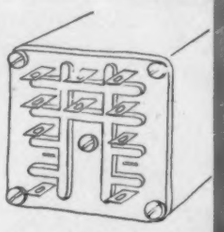
FRESH IDEAS IN RELAYS...



CHOICE of below-chassis or above-chassis connecting in plastic enclosures.



MULTI-USE terminals allow soldering, insertion in printed circuit board, and use of AMP Style 110 push-on terminals.



ALL TERMINALS on *one* panel... permits insertion in printed circuit board.

SPECIFICATIONS

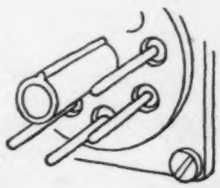
CONTACTS: *Integral with terminals;* up to 3PDT; 5 amp, 115 VAC or 32 VDC. Stationary contacts, fine silver inlay material; movable, solid fine silver.

COILS: Up to 230 VAC at 60 cps or 115 VDC.

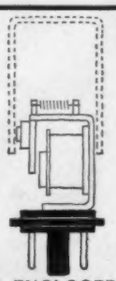
ENCLOSURES: Clear plastic.

TERMINAL PANELS: Barrier type or octal plug.

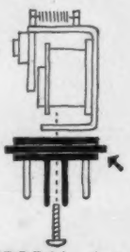
LATCHING RELAY: Available enclosed in clear plastic with plug-in mounting; or unenclosed.



OCTAL PLUG relays up to DPDT have recessed pin bases... meet UL spacing requirements to 150 V.



ALL ENCLOSED relays mount solidly on base... *not* on covers.



INTEGRAL plug-in base up to DPDT avoids wiring between contact terminals and pins.

OHMITE'S New "GR" Series

Stocked for Immediate Delivery From Distributors or Factory...

WRITE FOR BULLETIN 166

OHMITE

OHMITE MANUFACTURING COMPANY
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Skokie, Illinois

Rheostats • Power Resistors
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Variable Transformers
Tantalum Capacitors • Tap Switches
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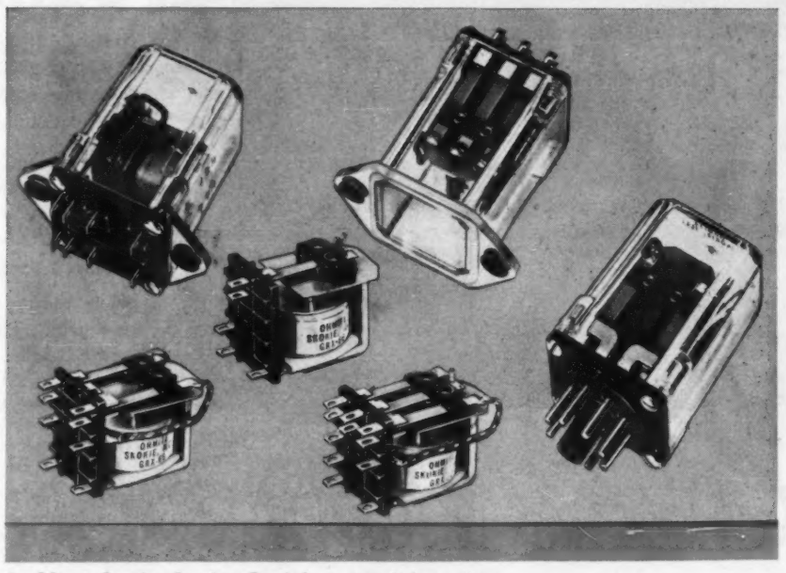

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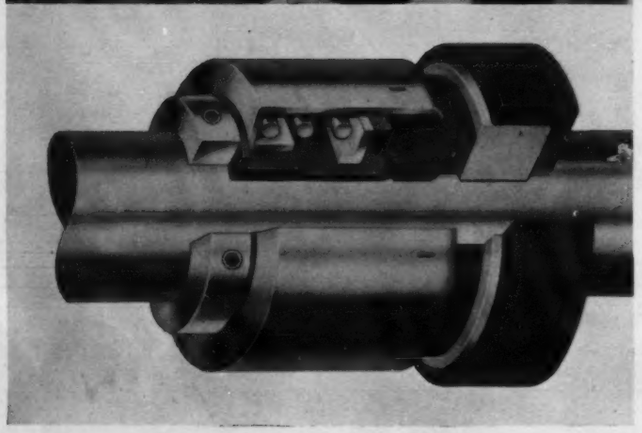

MECHANICAL SEALS in Design Engineering

Here's a sure way to maintain tight sealing under severe conditions—design with Garlock PK Mechanical Seals. Over the years, user after user has expressed complete confidence in Garlock PK MECHANIPAK Mechanical Seals. One such example is the Construction Machinery Company, a leading producer of contractor and irrigation pumps. They had a problem of maintaining an air-tight seal along the shaft of end suction and self-priming centrifugal pumps to keep the suction lift operating at maximum efficiency.

To do the job properly, Garlock PK MECHANIPAK seals were specified. Since the original installation nearly 10 years ago, the seals have done the job well at pressures to 150 p.s.i., on shafts with speeds to 3500 r.p.m., and where muddy, silt-laden water churns violently without letup. Long life, less downtime, and greater convenience are just a few of the benefits realized; Construction Machinery is particularly pleased with the easy to install, self-contained "package" construction of Garlock PK MECHANIPAK Seals.

Pass this fine performance on to your customers. Design to include Garlock PK Mechanical Seals on centrifugal pumps, automatic washers, dishwashers, gear boxes, speed reducers. The seals will perform effectively at temperatures to 212°F, pressures to 150 p.s.i., shaft speeds to 2000 f.p.m. Your local Garlock representative has complete information. Call him at the nearest of the 26 sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-150. Garlock Inc., Palmyra, N.Y.

Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Company

Order from the complete line of quality Garlock products... Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

Garlock PK MECHANIPAK* Seals keep dirty water from motor, help maintain long suction lift by preventing air leakage on Construction Machinery Company pumps (top).

*Registered Trademark

GARLOCK

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PATENTS

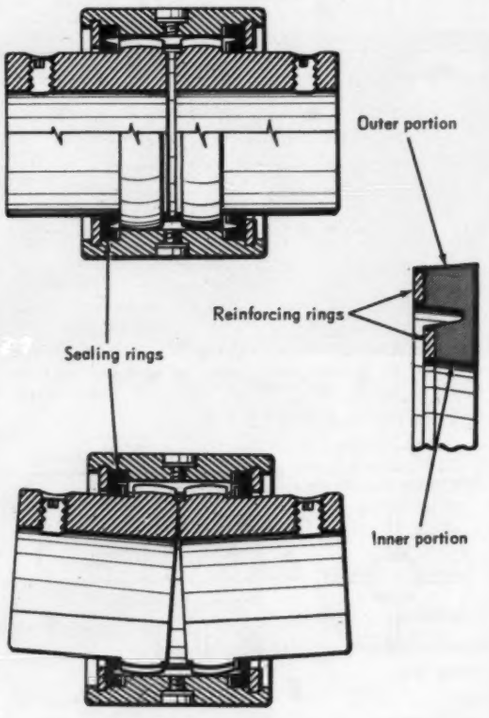
Sealing Rings

U. S. Patent 2,974,501; Samuel S. Kaufman and James A. Vargas, assignors to Sier-Bath Gear & Pump Co., Inc., North Bergen, N. J.

The sealing rings covered by this patent are designed for use with self-aligning gear-type flexible shaft couplings. The ring will maintain sealing action and compensate for extreme angular and/or parallel displacement of coupling members while the seal is rotating.

The ring consists of an outer resilient portion and inner resilient portion interconnected by an intermediate section of less thickness. The middle section provides a distortable torsionally resilient connection and serves as a pivotal axis for movement of inner and outer portions. The outer portion is of slightly greater thickness than the inner portion. A reinforcing ring is mounted on the face of the outer ring portion. The reinforcing ring is of hard metal to take abrasive or gouging forces that will be exerted upon the sealing ring.

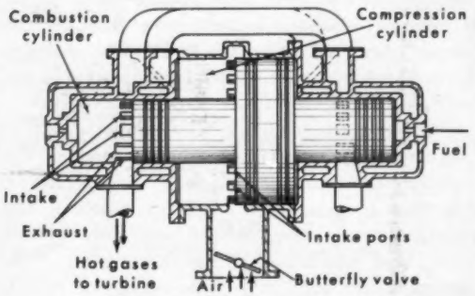
A reinforcing ring is also bonded to the face of the inner ring. The inner diameter of the ring is not bonded to the inner flexible ring. The outer and inner flexible rings are tapered.



Free-Piston Compressor-Burner

French Patent 1,228,616; Alfred H. Muller, assignor to Daimler-Benz Aktiengesellschaft, Stuttgart, Germany.

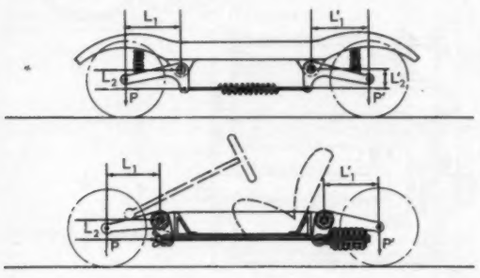
This patent describes a simple free-piston compressor-burner for gas turbines. Air is drawn through a butterfly valve into a large-bore cylinder. The piston has a large central diameter and two smaller diameter portions which move in opposed cylinders. Each of the smaller cylinders acts as a two-stroke, internal-combustion unit. Air compressed in the right-hand space of the large cylinder is admitted to the left combustion cylinder and vice versa. Exhaust gases are fed to the gas turbine (not shown).



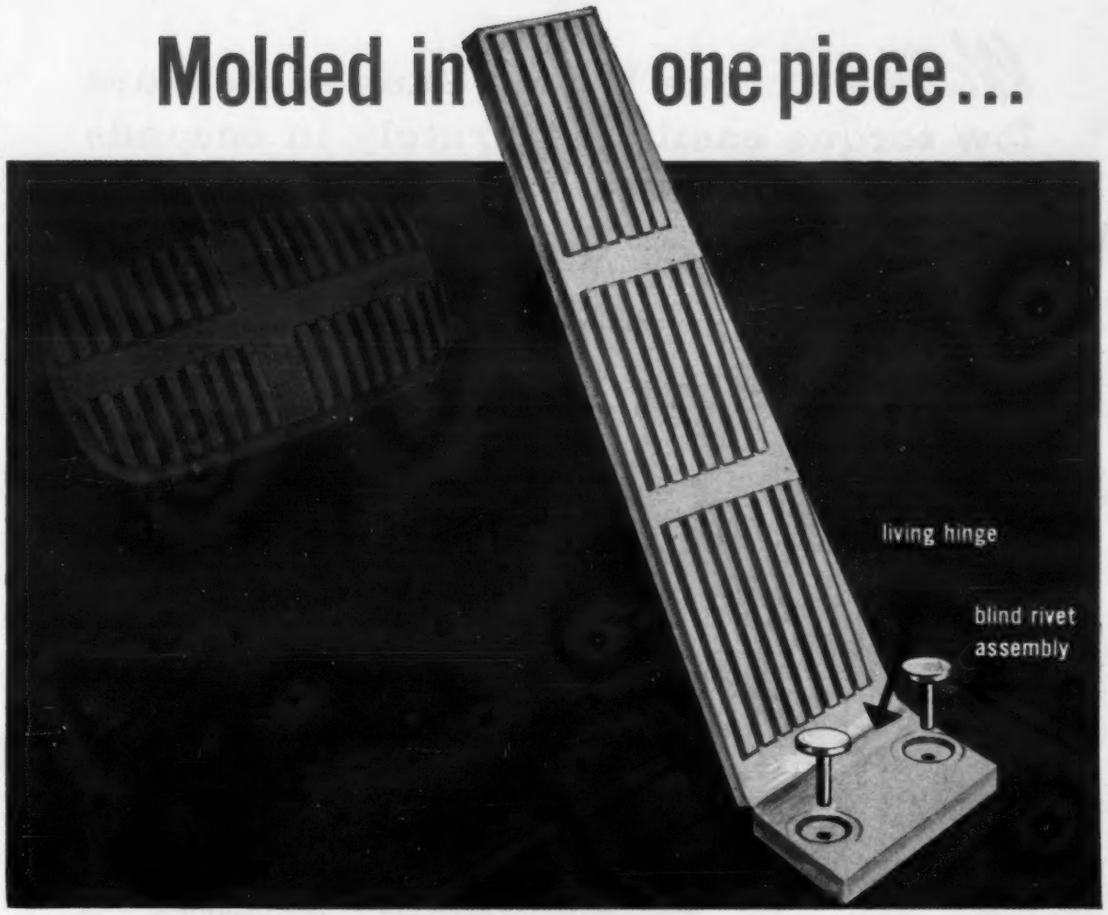
Vehicle Suspension

French Patent 1,231,636; M. F. A. Julien and Paulstra Corp., Paris, France.

Corresponding front and rear wheels are connected by an elastic rod whose tension compensates for the weight of the car. Auxiliary springing of each wheel-carrying lever is used only to absorb shocks and other forces arising from the movement of the car. This is achieved by equalizing reactions on each lever so that: $(P)\ (L_1/L_2) = (P')\ (L'_1/L'_2)$. Dynamic springing is by means of rubber or similar torsion shafts and/or combinations of steel spring and/or pneumatic or hydro-pneumatic cushions. Advantage of the design is claimed to be the complete separation between static and dynamic springing by simple means.



Molded in one piece...



the hinge lives on and on... because it's Escon® polypropylene

Escon polypropylene defies fatigue—a fact demonstrated by the integral hinge molded into this accelerator pedal, which easily passes the severe requirements of the automotive industry. The high strength and resilience of Escon polypropylene permit blind rivet assembly for fast, economical mounting to the floor panel.

Escon polypropylene parts are being investigated by auto makers to solve many difficult design problems. Glove compartments with "living hinges" molded in one piece, for example, promise to cut assembly costs and improve performance.

Besides exceptional dynamic fatigue resistance, Escon polypropylene gives you outstanding design versatility, high strength, low volume cost, easy processing, chemical resistance, negligible water pick-up, high heat distortion point and excellent electrical properties. For test samples or technical assistance, write to Enjay, 15 West 51st Street, New York 19, New York.

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ENJAY CHEMICAL COMPANY

A DIVISION OF HUMBLE OIL & REFINING COMPANY

ENJAY PLASTICS

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Waters Torque Watch Gauges measure low torque easily, accurately in seconds . . . here are just 4 of hundreds of uses

Checking airborne camera unit

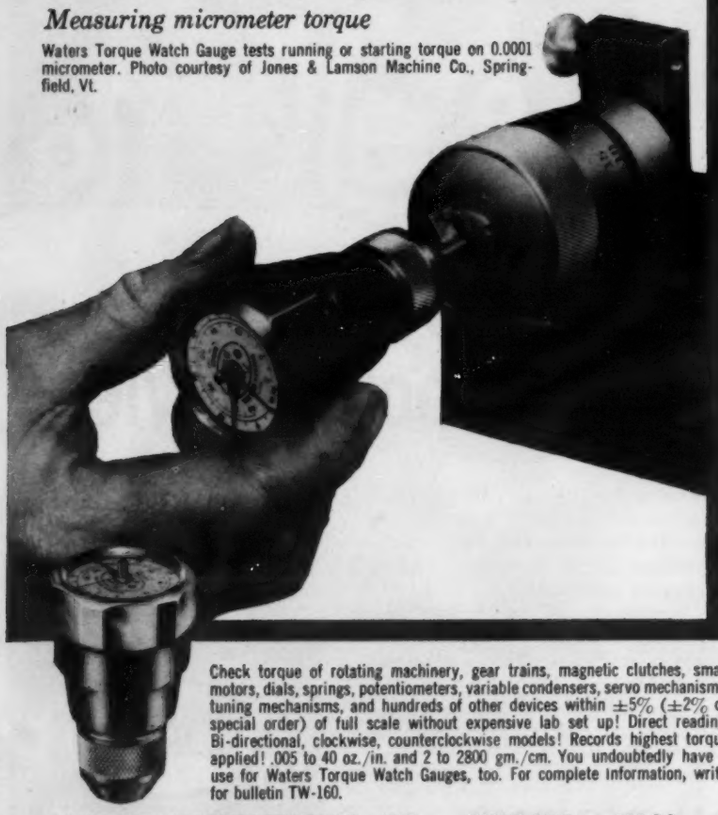
Arrows indicate Waters Torque Watch Gauges in test fixtures used to check unit for airborne camera control system. Unit includes power supply, servo amplifiers and computer. Photo courtesy of Chicago Aerial Industries, Barrington, Ill.

Checking gear train assembly

Waters Torque Watch Gauge measures torque on output shaft of gear train assembly. Photo courtesy of U. S. Gear Corporation, Wakefield, Mass.

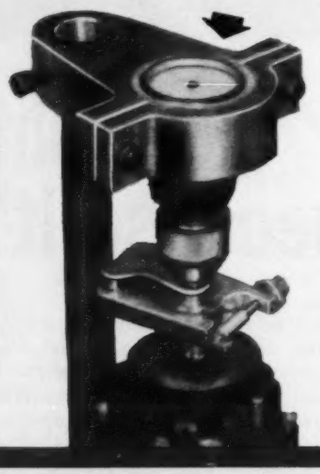
Measuring micrometer torque

Waters Torque Watch Gauge tests running or starting torque on 0.0001 micrometer. Photo courtesy of Jones & Lamson Machine Co., Springfield, Vt.



Testing turntable drive

Arrow indicates Waters Torque Watch Gauge used to measure motor drive mechanisms for juke box turntables. Photo courtesy of Seeburg Corp., Chicago, Ill.



Check torque of rotating machinery, gear trains, magnetic clutches, small motors, dials, springs, potentiometers, variable condensers, servo mechanisms, tuning mechanisms, and hundreds of other devices within ±5% (±2% on special order) of full scale without expensive lab set up! Direct reading. Bi-directional, clockwise, counterclockwise models! Records highest torque applied! .005 to 40 oz./in. and 2 to 2800 gm./cm. You undoubtedly have a use for Waters Torque Watch Gauges, too. For complete information, write for bulletin TW-160.

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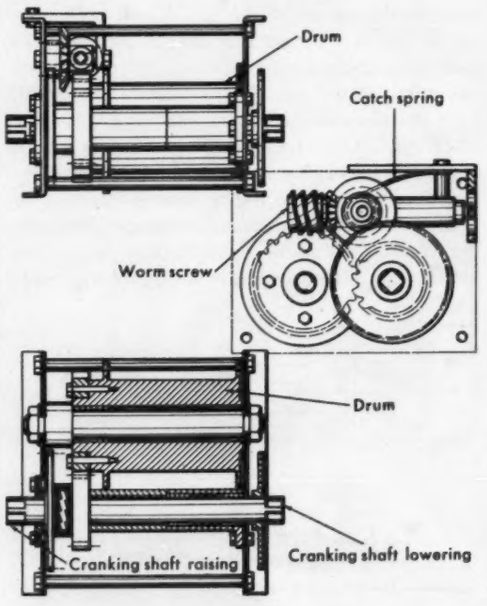
Automatic Cable Winch

French Patent 1,242,976; M. B. Combes, Paris, France.

To pull loads up, the cable-drum driving gear of this winch is driven by a straight gear wheel connected with its shaft by a toothed clutch. The clutch is engaged through lateral displacement of this shaft (to the right in the illustration). This movement frees the safety pin through displacement of the safety disc, and allows the worm screw to pivot on its angle pinion driving shaft and escape the teeth of the drum gear. Special design of these teeth keeps the worm from rotating, but allows it to serve as a catch for the drum wheel, retaining the load. The worm is forced back by a spring after each pivoting movement to engage the teeth of the drum wheel.

To lower the load, the winch must rotate in the opposite direction; the crank is placed on the opposite end of the driving shaft. When cranked, the shaft is engaged by the tooth clutch to the auxiliary gear wheel, which previously rotated freely and which now drives the worm gear by means of two bevel gears. The worm gear now is maintained in engaged position with the drum gear wheel by the safety pin, pushed by the safety disc. Movement of the drum now is allowed through the irreversible action of the worm gear and can be as slow as desired, with a minimum of effort, of energy dissipation and of efficiency loss.



The following list compiled from recent issues of the Patent Gazette gives you increased coverage of new patents whose details may be useful to product and machine designers. Copies may be obtained from the U. S. Commissioner of Patents, Washington, D. C. The price is 25c each.

HYDRAULIC CONTROL SYSTEMS
U S Patent 2,979,908; William M. Shook, assignor to The Warner & Swasey Co., Cleveland, Ohio.

FLEXIBLE SHAFT COUPLINGS
U S Patent 2,979,925; Philip C. Hungerford, Jr., assignor to Curtiss-Wright Corp., Dayton, Ohio.

FLUID FLOW METER
U S Patent 2,979,948; Edward S. Gwathmey, assignor to Specialties, Inc., Syosset, N. Y.

CHANGE-SPEED GEARING
U S Patent 2,979,969; Ludwig J. Fichter, assignor to Oak Mfg. Co., Delaware.

VARIABLE-SPEED TRANSMISSION
U S Patent 2,979,970; William S. Rouverol, Berkeley, Calif.

VARIABLE-DELIVERY POSITIVE-DISPLACEMENT PUMP
U S Patent 2,980,024; Joseph A. Pope, assignor to Rolls-Royce, Ltd., Derby, England.

WOBBLE PLATE PUMP
U S Patent 2,980,025; Gunnar A. Wahlmark, assignor to Borg-Warner Corp., Chicago, Ill.

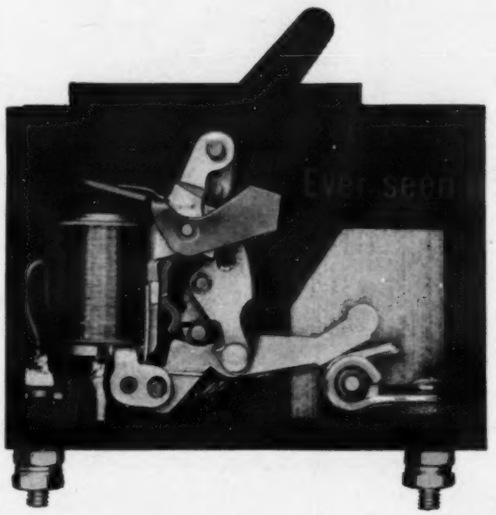
BOOSTER MECHANISM
U S Patent 2,980,066; William Stelzer and David T. Ayers, Jr., assignors to Kelsey-Hayes Co., Detroit, Mich.

MECHANICAL COMPUTING DEVICE
U S Patent 2,980,069; Eugene B. Hilker, Warren H. Cowles, George B. Stroh and Robert S. Flemming, assignors to Holley Carburetor Co., Van Dyke, Mich.

FLEXIBLE HOSE CONSTRUCTION
U S Patent 2,980,144; Cyril J. Edwards, Jr., and Rollin E. Winegar, assignors to The Eagle-Picher Co., Cincinnati, Ohio.

CHANGE-SPEED GEARS
U S Patent 2,980,209; Edward J. Rabson, assignor to Hardy Spicer, Ltd., Birmingham, England.

SAFETY PRESSURE-RELIEF DEVICE SUPPORT
U S Patent 2,980,286; Robert S. Coffman, assignor to Black, Sivalls & Bryson, Inc., Kansas City, Mo.



ten-milliamp circuit breaker? You have now. This Heinemann hydraulic-magnetic circuit breaker is rated at exactly 0.010 amperes. We could just as easily have made its rating 0.5 or 1.7 amps or, for that matter, any integral or fractional current value you might spec, up to 100 amps. A simple change in the winding of the solenoid overload coil would do the trick. • When you need precise overcurrent protection, even at very low current levels, think of the possibilities of the Heinemann breaker. It is temperature stable (no de-rating or trip-point juggling); it is available with any of several inverse time delays (or instantaneous-trip action); and it can be had in models ranging in size from subminiature on up. The Heinemann Engineering Guide, Bulletin 201, will give you detailed information. Write for a copy.

HEINEMANN ELECTRIC COMPANY ◆ 105 BRUNSWICK PIKE, TRENTON 2, N.J.

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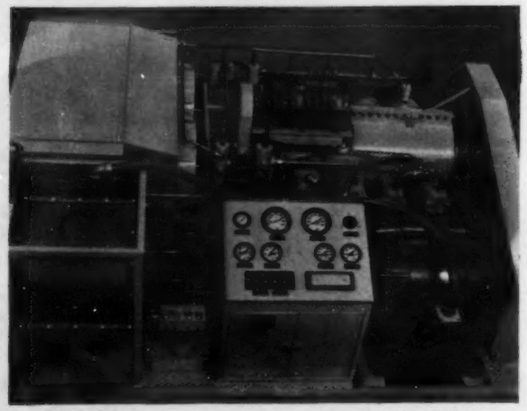

MODEL DPB-CCS Four-stage, 8-cylinder compressor. System includes full dehydration and oil removal, filter and complete control panel. Backed by Cardair's 20 years of high pressure gas experience. The only ICBM type compressor qualified by 2500 hour life test.

CCC CARDAIR CENTRAL COMPRESSION SYSTEMS

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- with less than 1 ppm oil content
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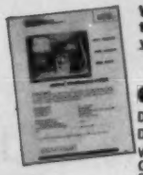
In addition to air, helium and nitrogen, it can be easily adapted to other gases including hydrocarbons and hydrogen. Pressure range is from 3500 to 12,000 psi in continuous service and to 15,000 psi intermittently. Complete dehydration and oil removal equipment are included.

For either testing or production, it may also be used as a central high pressure source for diverse locations, with Cardair supplying the complete system.

Maintenance is simple and minimal, with nationwide Cardair service facilities. Installation is easy—no heavy concrete base is required.



Write today for illustration sheet and technical data—or send us information on your particular high pressure supply needs.

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DESIGN IDEAS NEWS

ELECTRICAL

Thermistor Sensing Circuit Provides ±0.005C Control of Bath

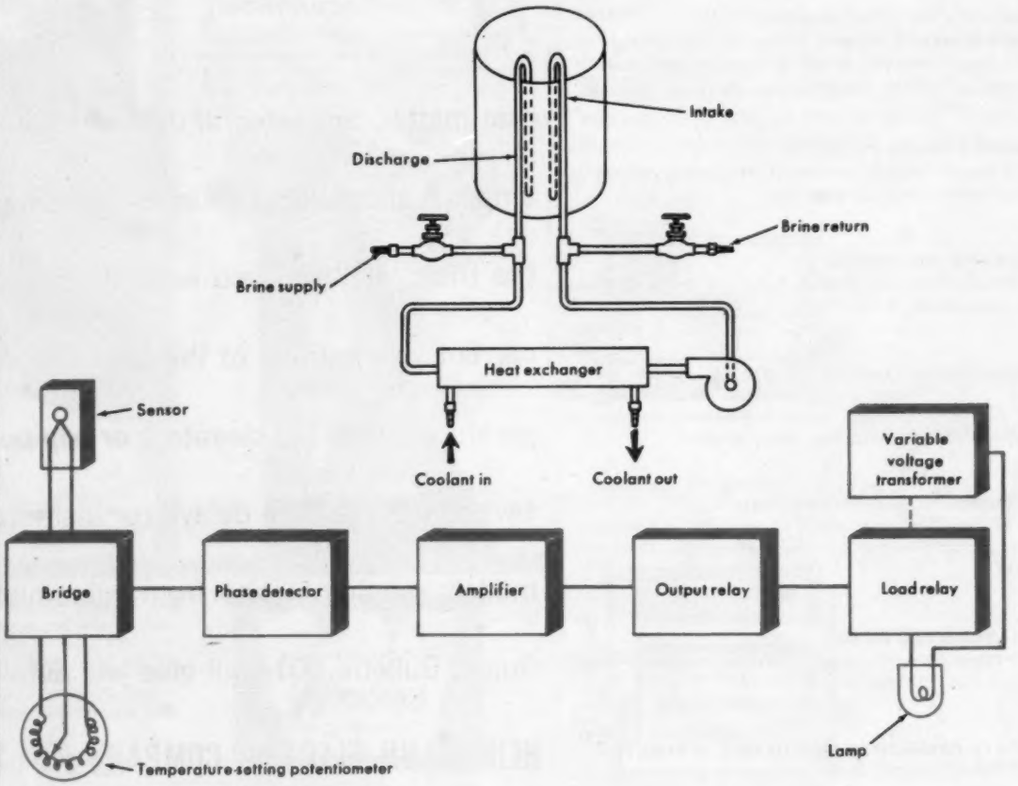
Lars G. Soderholm, Midwest Editor

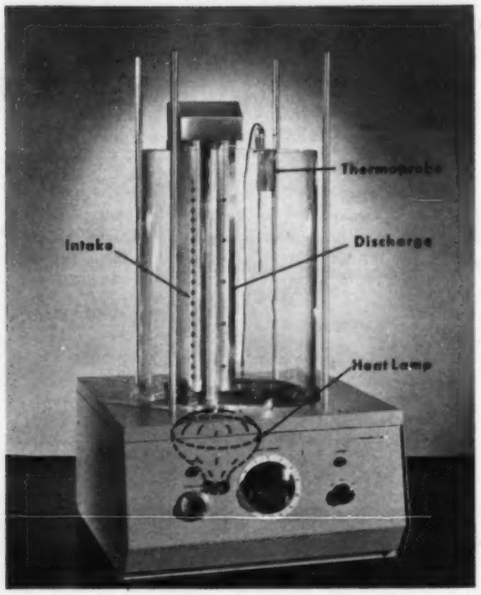
An accurate radiant-heat bath uses a thermistor-control circuit to detect and hold temperatures to ±0.005C within a 12-inch-dia by 18-inch-high glass tank. This can be done for temperatures both above and below ambient through a combination of control positions, including: full-line voltage to heat lamp, controlled-line voltage adjusted through a variable-voltage transformer, off position and a cooling position utilizing either tap water or a refrigerant.

A constant-temperature bath is used either as a source of fluid or as a medium in which to perform work directly. The new radiant heat bath was designed for accurate temperature control and for convenience in use.

Heat to the test tank is supplied by a 500w radiant-heat lamp mounted beneath the tank. The tank rests on a silicon ring gasket which, in addition to providing a seat for the tank, acts to direct condensate which may run down the outside of the tank into a gutter from which it can be removed from the equipment via a drainage outlet.

The controlled fluid is circulated through inlet and outlet "snorkles" that project downward just inside the edge of the tank. The inlet "snorkle", which removes fluid from the bath, has a series of 20 equally spaced openings removing fluid from every level of the tank. The outlet "snorkle", which returns the fluid, has 15 openings discharging fluid parallel to the tank wall and five openings discharging fluid radially toward center of the tank. The fluid is circulated by an 8- to 10-gpm centrifugal pump through a heat exchanger. Brine return and supply





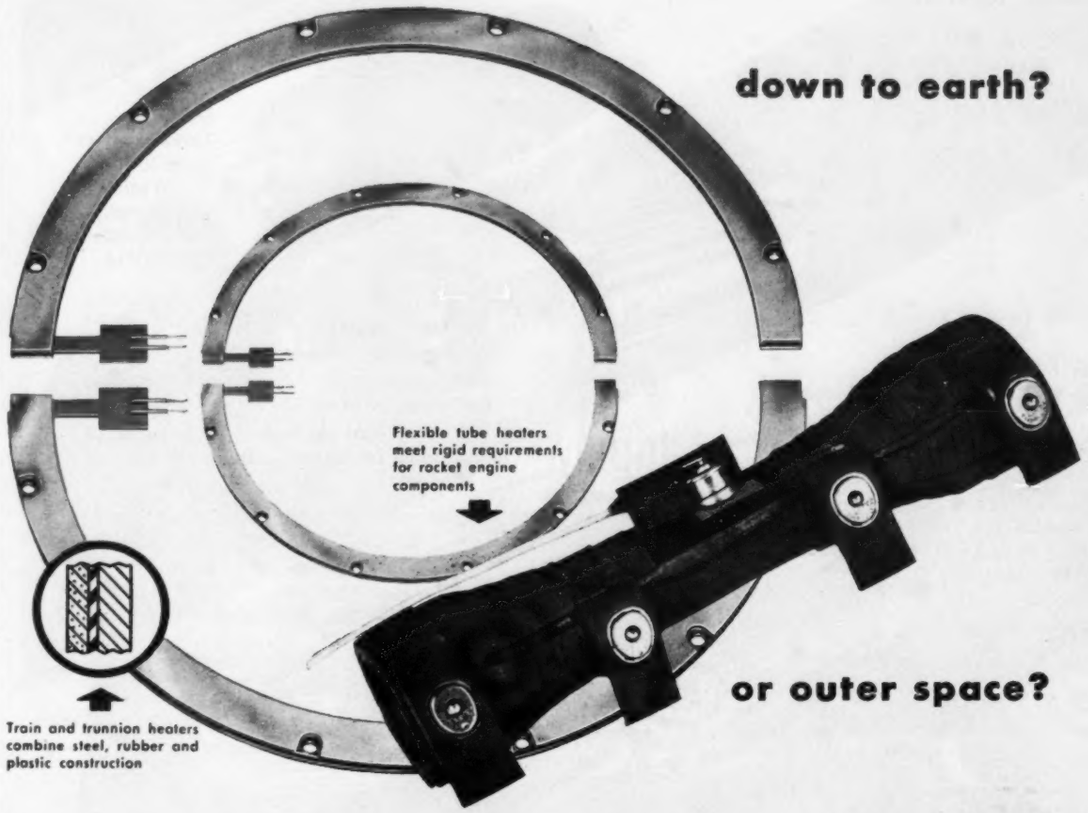
connections permit the circulation of the controlled-temperature media, if desired.

For temperature control, a thermistor mounted in a sensing probe is balanced against a temperature-adjustment potentiometer in a bridge circuit. Unbalance, caused by temperature deviation, is sensed by a phase detector which operates through an amplifier to actuate a relay. The relay, depending on the control setting, provides either full-line voltage to the heat lamp or a controlled-adjustable voltage, or shuts off the current entirely.

For controlling temperatures below ambient, the radiant-heat bath unit is operated in the low setting. In this position the cooling water supply is set slightly in excess of the amount of heat transferred by convection and conduction to the normal surroundings. The cooling effect is balanced then by heat added by the heat lamp set at a controlled-voltage setting.

For controlling high temperatures (above ambient), the unit is operated in its high setting. It then operates between full-line voltage and the controlled-voltage setting. The controlled voltage determines the rate at which the temperature is allowed to drop after the sensing point is reached and must be adjusted carefully to get a reasonable temperature-cycling rate.

The radiant-heat bath can provide temperature control from tap water temperatures (or below with refrigeration) to about 60C. It is part of the "Hi-Accuracy" line of baths manufactured by Labline, Inc., Chicago, Ill.


down to earth?
Flexible tube heaters meet rigid requirements for rocket engine components
or outer space?
Train and trunnion heaters combine steel, rubber and plastic construction

SAFEWAY Heat Elements apply engineering imagination to all defrosting, de-icing and heating problems

Unusual and intricate *cold-control* problems frequently find their way to us. The circular heat elements shown above are components of vital ground support equipment. Exacting specifications called for the "sandwiching" of a continuous, circular heating element between two rings of different materials. The actual heating element is encased in silicone rubber and then bonded under controlled heat and pressure to two external rings: one of *silicone-resin impregnated fiberglas* and the other of *stainless steel*. The completed unit must withstand lengthy soak-testing in a salt water solution. Outside diameters of the train and trunnion rings are 56 ⅞" and 29⅜", respectively.

The flexible tube heater illustrated is another successful solution to a complex flight propulsion system heating problem. In this instance, custom-made flexible tube heaters have resistance wire molded in silicone rubber. Result—uniformly *dependable* heat is provided for rocket engine components.

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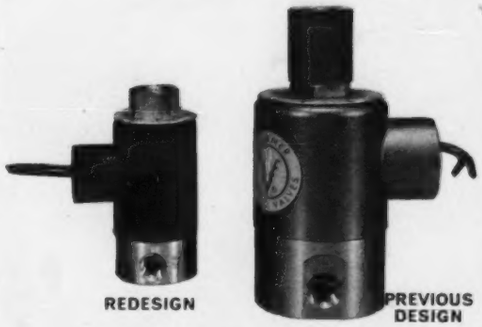
Internal Spring and Slotted

Victor W. Wigotsky, Eastern Editor



An internal spring acts against a slotted bushing in a new line of miniaturized solenoid valves. The spring and bushing combination facilitated reducing the valve to a 1-inch OD. Design is part of a series of miniaturized standard two-way and three-way valves which have the same capacity as larger units having identical orifice sizes.

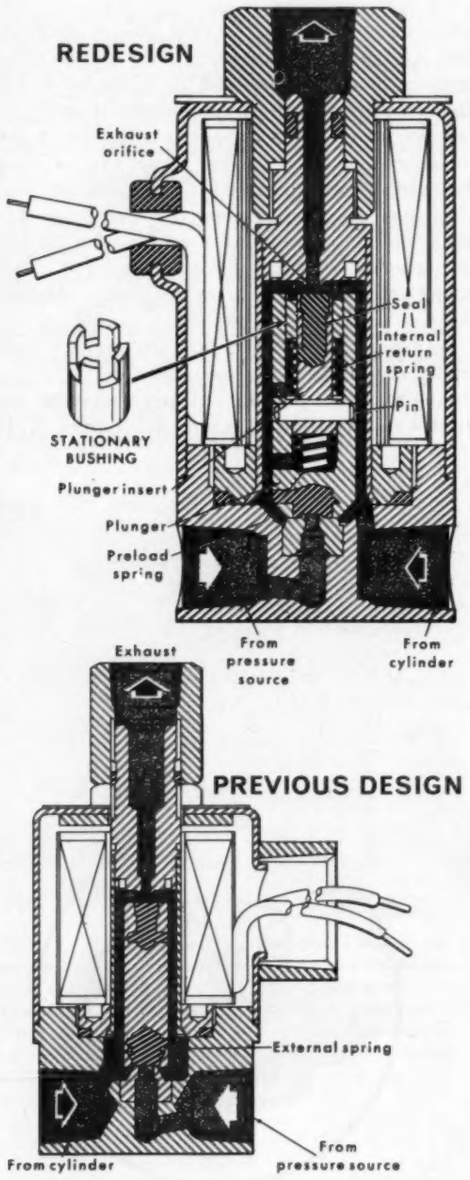
An external spring and a flange which increased the main body and sleeve diameter in the original valves are eliminated. In the miniaturized valve, the return spring is an internal element within the plunger assembly and functions with the slotted bushing. The spring acting against the stationary bushing provides enough force to return the plunger to its de-energized position and to reseal the inlet orifice. Bushing slots then permit flow to exhaust.

The B Series miniaturized solenoid valves are designed by Skinner Electric Valve Div. of Skinner Precision Industries, Inc., New Britain, Conn.

INTERNAL SPRING AND SLOTTED BUSHING of miniaturized valve eliminate space-consuming external spring and flange of original design. When miniature valve is in de-energized position, fluid exhausts from cylinder through four slots milled along outside surface of plunger. Slotted stationary bushing then permits flow through exhaust orifice. When energized, plunger assembly moves against stop to seal exhaust orifice and open inlet for pressurized flow to cylinder. Internal return spring compresses against stationary bushing. Plunger insert moves in opposite direction through small gap as seal closes against exhaust orifice. When valve is again de-energized, internal spring returns plunger assembly to seal inlet orifice and permits exhaust of pressurized fluid. Pin carries plunger insert with plunger assembly to open exhaust orifice.

Bushing Reduce Valve Size

BODY AND OPERATING PARTS are stainless steel. Unit is 2¼ inches high, weighs 5 oz and contains 3/64-inch inlet and exhaust orifices. Valves operate from zero to 150 psi and may be mounted in any position.



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NEW PRODUCTS

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Electrohydraulic Servovalve 301

Delivers 0 to 2 GPM

The miniaturized servovalve is compatible with all known hydraulic fluids, weighs only 2 oz and is 2⅛ inches long by 1-1/16 inches dia. The in-line force feedback system, pressure-balanced construction and single-nozzle design of the "Mini-Valve" assure high reliability and proportional flow versus input signal at low cost. Clogging in the valve is reduced as a result of its large single-nozzle construction. Particles of 200-micron magnitude pass through the orifice, providing smooth and accurate servo control. Nylon seals and stainless-steel fluid areas make the Model SV-128 useful for applications using all known hydraulic fluids. A range of fluids from water to acid can be passed through the valve for periods up to 10 years without adverse effects to the valve. Activated by a weak pulse, the builtin force motor moves in-line system to control flow of hydraulic fluid. This design reduces much of the friction which increases the effectiveness and life of the valve. The plug-in mounting feature simplifies and speeds installation or removal. Valve is inserted into a prepared bore and screwdown collar ring is hand tightened. Pressure-balanced construction and flexible nylon seal assure extremely low leakage. The unit is suited to a wide list of applications for low-cost, dependable servo control. Examples of its use include industrial automation machinery; construction and marine equipment; space, missile and airframe vehicles, or wherever 0-2 gpm compact, lightweight, rugged servo control is needed.

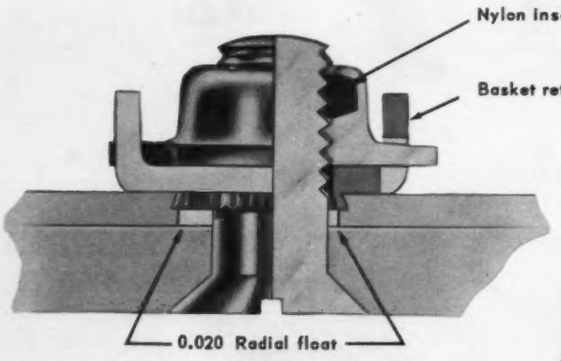
Sanders Associates, Inc., Instrumentation and Control Systems Dept., 95 Canal St., Nashua, N. H.

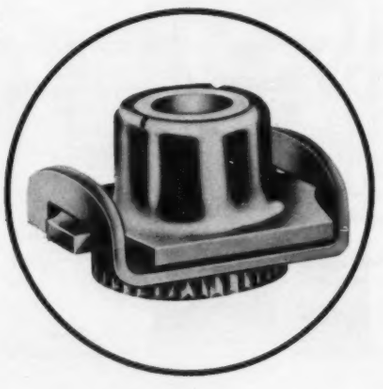
Miniaturized Floating Clinch Fastener 302

Self-Threads in Thin Sheet Metal

Greater tolerances for mating assemblies and simplified installation methods are the important advantages offered to the user by the floating clinch nut. The self-re-retained, clinch-type, "blind" fastener (Type NC4284) provides load-bearing threads in thin sheet-metal assemblies such as electronic chassis, instrument panels and cover plates. In the new design, a nut with two small lugs is retained in a window-type basket which provides a 0.020-inch radial float. This "float" means that the nut can compensate automatically for minor bolt-hole misalignment of the components being attached. The bracket also has a short, knurled shank which is swaged flush into a punched or drilled hole in aluminum or soft-steel sheets. The self-locking unit is manufactured both from carbon steel and 18-8 stainless in machine screw sizes No. 4, 6, 8 and 10. For each thread size, a series of three baskets with alternate shank lengths of 0.040, 0.060 or 0.090 inch is offered for easy flush installation in sections of equivalent thicknesses. Locking device is a special red nylon insert which withstands temperatures up to 350F.

Elastic Stop Nut Corp. of America, 2330 Vauxhall Rd., Union, N. J.



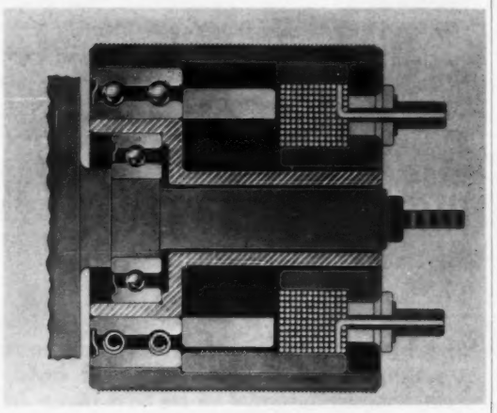


Ball-Bearing Assembly 303

Operates Electromagnetically

A "Dynamic Bearing" consists of a bearing within a bearing, the outer ring of the inner bearing being oscillated by a builtin electromagnetic drive. This action keeps the middle ring of the two bearings in motion, cancelling out friction torque resisting normal rotation of bearing and resulting in near-zero bearing friction. Running torque is lower than in conventional precision bearings; starting torque, which in conventional bearings is two to three times as high as running torque, is the same low value as running torque in electromagnetically driven bearing. Principal applications for bearing assembly are gyro gimbals, stable platforms, ultrasensitive scales and static balancing devices. Widest present use of the bearing is in retrofit programs through which older types of gyros for military aircraft are upgraded in performance with a minimum of design changes. Bearings are manufactured from 0.0469-inch bore to over 3 inches OD for instruments, weapon systems, computers and other high-quality equipment.

Barden Corp., Danbury, Conn.



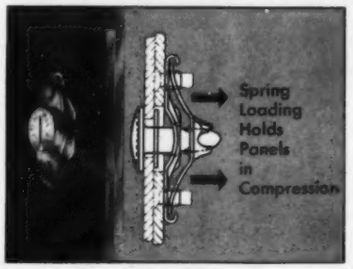
CUTAWAY of bearing shows bearing-within-a-bearing construction. Inner bearing supports gimbal pivot which must be free to rotate with a minimum of friction. Outer ring is mounted in threaded housing. In operation middle member is oscillated magnetically, in turn oscillating outer ring of critical inner bearing, resulting in minimum bearing friction at supported gimbal.

Quick-Opening Fasteners

Selecting Small Fastenings for Metal Closures

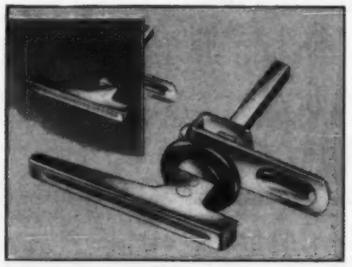
*"Use captive fasteners wherever feasible . . . Avoid the use of loose washers and loose nuts . . . Fasteners on equipment covers should be operable either with no tools or with standard hand tools"**

(John D. Folley, Jr. & James W. Altman, Research Scientists, American Institute for Research)



Quarter-Turn Fastener

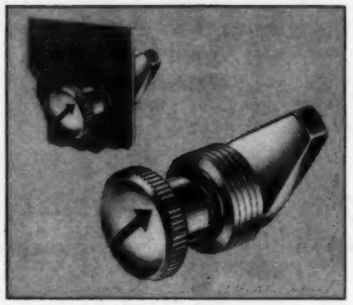
Lion Fasteners open and close with a ¼ turn, hold sheets tightly under the compression of a rugged spring. Quickly operated and fully retained in the outer panel, they are approved under U. S. Government military specifications. Stud and receptacle float for easy alignment and simplified hole preparation. Flush, oval, wing, knurled, ring, and key head styles available. Sizes—No. 2, No. 5, and High Strength for extra heavy duty.



Cabinet Latch

Just drill a hole, push the fastener stem through, and slide the special push-on clip into place. No welds, screws, bolts or rivets: the fastener is permanently installed in seconds!

Adjustable to any grip length or panel thickness, the pawl is fixed in place by a single set screw. The fastener's brightly finished knob is set off by a plated washer. Also furnished with screwdriver operated flush head.

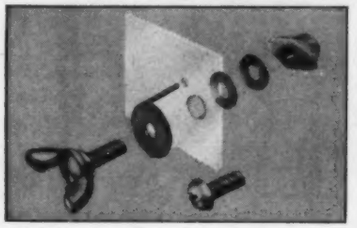


Spring Tension Latch

For fastening slide-out drawers and hinged panels the Southco Arrowhead Latch is recommended. It locks or opens with a quarter turn yet occupies less than ½" inside space.

Doors are held under spring tension—a push against the arrowhead knob relaxes this tension, allows operation with fingertip ease. Drill a single hole for installation—no fastening to the door is necessary. No striker plate is needed.

Pawl stop is eliminated—arrowhead shows at a glance exact position of pawl.



Adjustable Panel Latch

Small doors and panels can be fastened with greatest speed and lowest cost with the Southco Adjustable Latch.

The entire fastener is quickly installed through two holes punched in the door; no bolts or rivets are needed.

It operates with a quarter turn, requires no striker plate. An extra twist after the nylon pawl is engaged pulls up the door to form a seal and eliminate vibration.

Available with wing, knurled, or Phillips head.

Free Fastener Handbook

Send for your complete Southco Fastener Handbook, just printed. Gives complete engineering data on these and many other special fasteners.

Write on your letterhead to Southco Division, South Chester Corporation, 232 Industrial Highway, Lester, Pa.

SOUTHCO FASTENERS
LION

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* *Quotation from "Designing Electronic Equipment for Maintainability"; Machine Design, July 12, 1956.*

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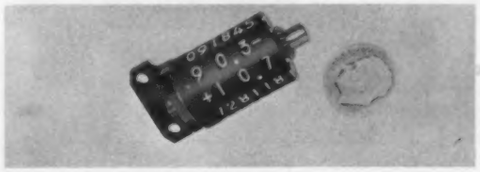
MECHANICAL

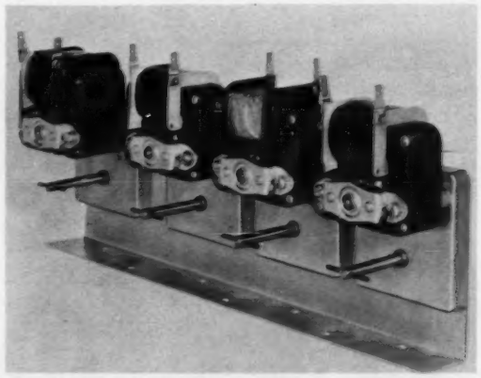
Miniature Add-Subtract Counter 304



The Type 30-130 variation counter is used for digital readout applications where plus-and-minus, right-and-left or directional readouts are required. The miniature device, as shown, can be driven to ±99.9 and is prevented from overrunning by builtin mechanical stops. The diameter of the drums is 0.672 inch and numerals are 0.125 inch high. Maximum torque is 0.25 oz-in at room temperature. Running speed is 350 rpm continuous with intermittent operation at 600 rpm. The counter can be mounted on a bracket as illustrated and driven by means of a through shaft from either side.

Melland Gear & Instrument Co., Inc., 88-06 Van Wyck Expressway, Jamaica 18, N. Y.

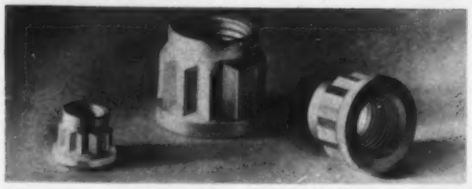
FHP Gear Motor Assembly 305



Individual gear motors assembled and fastened to a stamped-steel mounting plate offer advantages where several units are to be mounted in proximity to each other. Grouped together on a single bracket, installation is simplified and extra handling and mounting of individual motors are eliminated. Rotary components are available with any combination of output speeds and torque to meet specific requirements. As many as four fhp units can be provided, completely assembled and mounted.

Molon Motor & Coil Corp., 3737 Industrial Ave., Rolling Meadows, Ill.

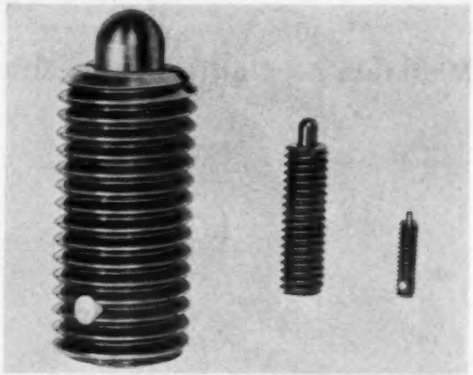
1400F Fastener 306



An elevated-temperature locknut is intended for use with high-performance bolting at temperatures to 1400F. Designated FN 1418, the one-piece, self-locking nut has properties which make it possible to utilize the full potential of high-strength 1200 and 1400F bolts. The fastener is also intended as a mate for the SPS EWB 1615 and BE 1615 nickel-base family of bolts. The FN 1418 also has limited application with these bolts up to 1600F. The unit is rated at a room-temperature tensile strength of 180,000 psi minimum. The minimum tensile rating at 1200F is 130,000 psi and at 1400F is 100,000 psi. The FN 1418 is a 12-point external-wrenching locknut available in sizes No. 10-32 through ½-20. Nuts are silver plated to AMS 2410. Prevailing torque type of lock has been formed for use on 0.003-inch reduced-diameter bolt threads.

Standard Pressed Steel Co., Jenkintown, Pa.

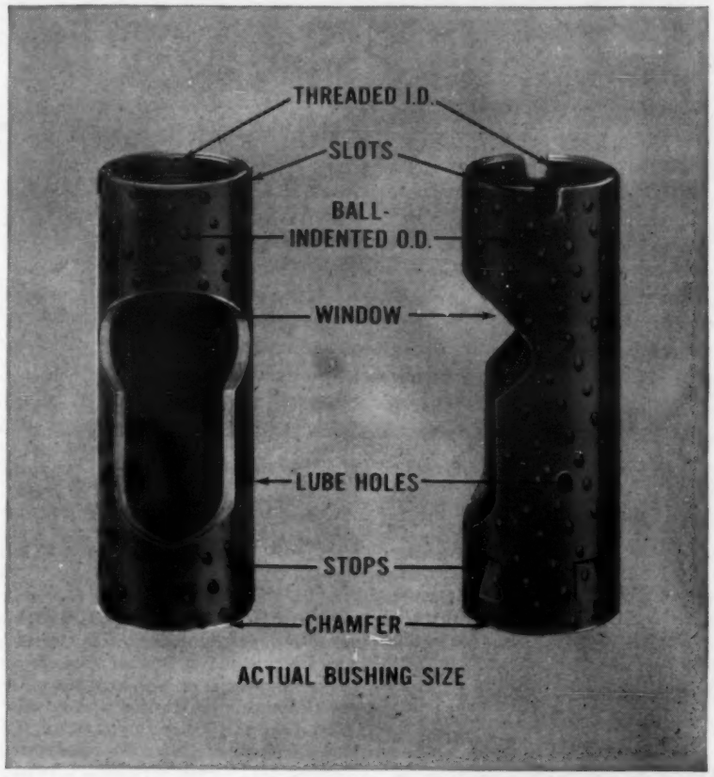
Self-Locking Spring Plungers 307



Nylon pellets have been incorporated in a complete line of spring plungers for use in dies, jigs, fixtures and detents. When a plunger is in place, compression of the nylon pellet (called "Nylock") creates a spring-like wedging action which locks mated threads together. Lock insert eliminates need for set screws or other more expensive methods of locking plungers. The consistent, self-locking torque permits quick and easy assembly and a positive lock that is vibrationproof. Plungers are available in thread sizes from 6-32 through 1 to 8 inches.

Harco Engineering, 12092 Woodbine Ave., Detroit 39, Mich.

"EXOTIC" BUSHING MAKES NEW STEERING DESIGN COME TRUE



INSIDE-OUT BUSHING HELPS PUT NEW STEERING MECHANISM INTO PRODUCTION! To perfect a new steering mechanism, an automotive manufacturer required a linkage component. Designers tried making it of machined steel, then plastic . . . both materials failed. But the unusual bushing shown at left, with a number of features F-M engineers helped designers incorporate, solved the problem. It is bronze-on-steel, formed with the ball-indented bronze on the O.D. so the bushing can accommodate sliding motion within the mechanism. A large window makes insertion of a ball socket easy during assembly. Design of the bushing also includes: stops near one end to hold a disc . . . a threaded I.D. on the other with slots for a locking pin . . . holes that supply lubricant to the outer surface. For the F-M customer, all these built-in features helped accomplish this result—easy, efficient assembly and success with a new design.

CAN F-M BUSHINGS SOLVE problems on your board or on your assembly line? Or perhaps a sleeve bearing, thrust washer or spacer? F-M, who makes them all, can provide the answer. F-M engineers, with a wealth of knowledge from years of experience, are available to help design the needed component. This complete technical assistance is one reason why these F-M products are widely specified for use in automobiles, farm equipment, construction machinery and many other products.

Additional information about bushings is provided in a Design Guide, published by F-M. Helpful literature is also available on sleeve bearings, thrust washers and spacer tubes. For your copies, write Federal-Mogul Division, Federal-Mogul-Bower Bearings, Inc., 11055 Shoemaker, Detroit 13, Michigan.

FEDERAL-MOGUL

sleeve bearings bushings-spacers thrust washers

DIVISION OF FEDERAL-MOGUL-BOWER BEARINGS, INC.

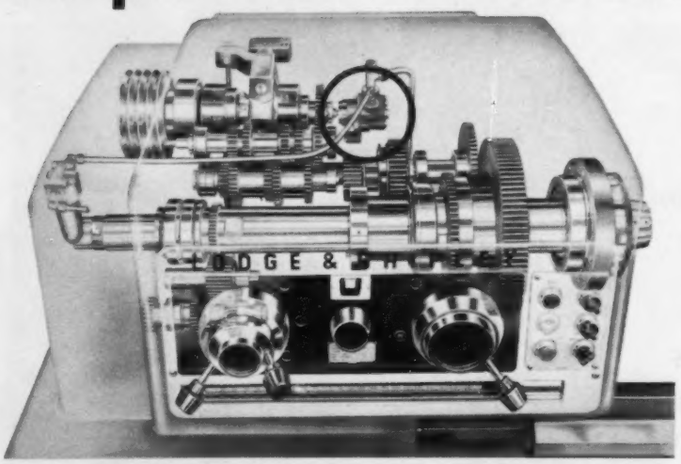
Circle 41 on Reader-Service Card for more information

How to select or design a pump for pressure lubrication

by E. H. Schanzlin
Chief Engineer, Tuthill Pump Company

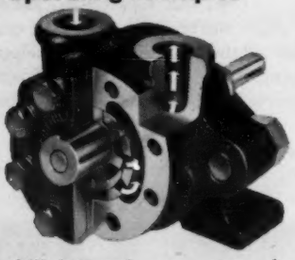
Our headline is something of a misnomer . . . for designing a pump for pressure lubrication today would be as pointless as designing a dowel pin.

Instead, there's a simple and increasingly popular answer to this problem. Practically every important manufacturer of air conditioning or large air compressors . . . manufacturers of machine tools . . . diesel engines . . . plus hundreds of manufacturers of diversified industrial equipment from valve operators to giant gear boxes . . . have selected Tuthill internal gear pumps for this demanding application because of compact size, economical price, quiet operation . . . and, above all, for their dependability, proven in over thirty years of operation.



Tuthill model ORL pump provides pressure lubrication for Lodge & Shipley POWERTURN lathes. Mounted in headstock area, this reversing pump is driven by a reversing clutch shaft, provides positive reversing action. Ports remain constant without use of valves.

Internal Gear Operating Principles



Tuthill internal gear pumps have only two moving parts. The pumping principle is based on the use of a rotor, idler gear, and a crescent shaped partition cast integral with the cover.

Power applied to the rotor is transmitted to the idler gear with which it meshes. The space between the outside diameter of the idler and the inside diameter of the rotor is sealed by the crescent.

As the pump starts, the teeth come out of mesh increasing the volume. This creates a vacuum, drawing the liquid into the pump through the suction port. The liquid fills the spaces between the teeth of the idler and the rotor, and is carried past the crescent partition to the pressure side of the pump. When the teeth mesh on the pressure side, the liquid is forced from the spaces and out through the discharge port.

Special Advantages of Reversing Pumps

Tuthill also offers a complete selection (375 models) of internal gear pumps with a special reversing feature. The unique construction of these units permits positive reversing action without the use of valves, and with the port positions remaining constant.

Reversing pumps are necessary when the lubrication pump must be driven by a reversing shaft, or when machinery must be shipped without knowing the ultimate direction of the driving unit.

A good example is shown above. A reversing pump is mounted directly on the reversing clutch shaft in the headstock area of Lodge & Shipley's POWERTURN lathes to provide dependable pressure lubrication of these outstanding machine tools.

Stripped or Cartridge Models

For extremely crowded applications, or extra economy, Tuthill also offers a complete selection of stripped and cartridge models, in which only the basic pumping elements are supplied for incorporation directly into your equipment. These units have been widely used to supply positive pressure lubrication and hydraulic power in many important applications.

Over 800 Models

Tuthill's complete selection of internal gear pumps includes over 800 different models from stock for capacities from ⅓ to 200 gpm; for pressures to 500 psi; and speeds to 3600 rpm. Specially designed housings, shaft extensions, relief valves and many other features can be developed by Tuthill engineers for specific applications.

Write for complete catalogue No. 100 . . . or send us drawings on your application so Tuthill's engineers can make specific suggestions.

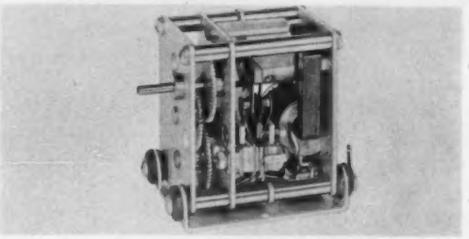
Tuthill manufactures a complete line of positive displacement rotary pumps in capacities from 1/3 to 200 gpm; for pressures to 1500 psi; speeds to 3600 rpm.

PUMPS FOR YOUR PURPOSE
TUTHILL PUMP COMPANY
943 East 95th Street, Chicago 19, Illinois

Circle 42 on Reader-Service Card for more information

MECHANICAL

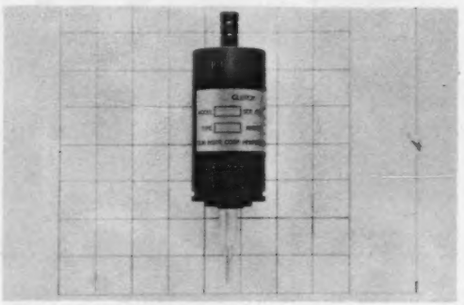
Constant-Speed D-C Motor 308



This motor-timer combination introduces a new and improved design—greatly reduced size and weight and more than 100-percent increase in torque. No governors or regulators are required. Speed is magnetically linked to reed frequency and speed cannot vary. Output shaft speeds are available as required from 1500 rpm to one revolution in 24 or more hr. Built to specifications or requirements, the d-c unit is offered in a wide range of operating voltages, torque, output-shaft speeds and switching arrangements. Current drain is low, permitting long operation from small batteries or other d-c supply.

Merchandising Advertisers, Inc., 410 E. Northwest Highway, Mt. Prospect, Ill.

Miniature Air Clutch 309



A Size 11 air clutch provides 318.4 oz-in of torque output. The unit is available in sizes from 5 to 18 with shaft sizes of 0.125- and 0.250-inch dia. Model AC-100 has two stainless-steel shafts, one within the other, extending from one end of housing. Shafts can be operated simultaneously or independently. A fitting for connection to air supply is at opposite end. Temperature range is from —5 to 400F. Applications are in missile and antisubmarine warfare systems requiring reliability without dependence on electrical systems.

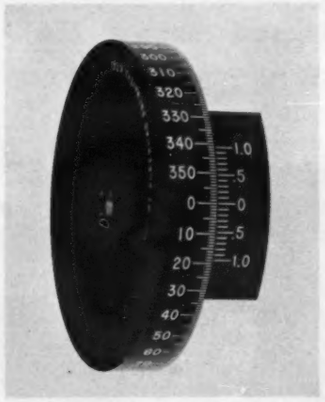
Elm Instrument Corp., 30 Chasner St., Hempstead, Long Island, N. Y.

Magnetic Clutch 310

Three separate operating modes may be performed within the Model MC-100 magnetic clutch. The device combines two clutches built into one housing. Three shafts extend from housing ends. At the front end, a 0.125-inch-dia shaft passes through clutch within 0.250-inch dia shaft. The other end has a 0.250-inch-dia shaft. Applying current to one coil or the other permits coupling the 0.250-inch-dia shaft individually or simultaneously to smaller shaft. The popular Size 11 unit measures 4.689 by 1.062 inches and weighs 8½ oz. The clutch offers 26-70 oz-in output torque at 24-28v d-c. Power consumption is 3w per coil. With backlash engaged the unit has approximately 5 minutes maximum.

Elm Instrument Corp., 30 Chasner St., Hempstead, Long Island, N. Y.

Precision Drum Dials 311



Calibrated for 1.0, 1.8, 2.0, and 3.6 deg, precision dials and verniers are offered in 1½, 2, 2½ and 3 inches (larger diameter as required). A choice of verniers reads 1/10 deg, 6 minutes and 15 minutes. Concentricity between 0.3750-dia hole and OD of drum is held to 0.0015 inch TIR and open side of drum could be to left or right.

Ackerman Engravers, 458 Broadway, New York, N. Y.

Circle 43 on Reader-Service Card

HOW TO MEASURE A NOISE YOU CAN'T HEAR

Vibrations detected by a sensitive pickup, then amplified and analyzed by electronic equipment, enable SKF engineers to measure almost imperceptible noises occurring in rotating ball and roller bearings. Based on long-continued investigation, noise and vibration appear to be almost solely the result of minute deviations in the surface geometry of the rolling elements and rings. Detection of this surface "waviness" as a source of bearing noise is an important SKF contribution towards solving the problem of producing quieter, smoother running bearings. Methods developed for minimizing waviness have already resulted in the quietest bearings yet made for electric motors and other equipment, as well as even greater precision in the high quality bearings for aero-space and similar applications.

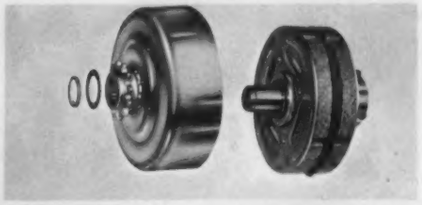
Advanced research is one of the reasons why SKF maintains its leadership in producing finer rolling contact bearings. Whatever bearings you need—ball, cylindrical roller, spherical roller, tapered roller or precision miniature types – you'll find SKF your assurance of dependable performance. SKF Industries Inc., Philadelphia 32, Pa.

6102

SKF MOTION ENGINEERING

Advanced ball and roller bearing technology

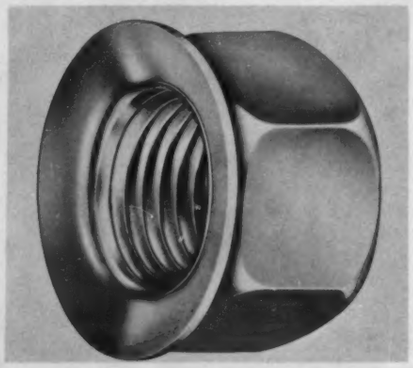
1500-RPM Clutch 312



Featuring a hardened and ground solid-shaft extension on which caged needle bearings ride, this rotary component is made for extra-rugged duty, allowing for long idling periods. It is designed for a ¾- or 1-inch shaft. Housing is constructed of heavy ⅛-inch gage with highly polished chrome finish. Unit will handle horsepower and torque capacity for engines up to and including 7 hp with full 360-deg shoe contact. The device is installed easily with two "Nylok" set screws to the outside. All shoes, springs, bearings and housings are replaceable; housings are interchangeable.

Automatic Steel Products, Inc., Mercury Clutch Div., 1201 Camden Ave., S. W., Canton, Ohio.

Conical Washers 313



This one-piece fastening device combines both a washer and a nut to simplify handling and mounting of silicon rectifiers and other stud-mounting devices. The preassembled unit provides economy in assembly time and labor and simplifies inventory control. Silicon-rectifier mounting units are available in sizes from 8-32 through ½-20 in carbon steel, corrosion-resistant steel, aluminum, brass and other suitable materials.

Illinois Tool Works, Shakeproof Div., St. Charles Rd., Elgin, Ill.

Your local Moline Chain OFFERS MORE

His engineering staff is capable of helping solve power transmission problems.

Your Moline distributor knows the power transmission business from A to Z, usually has the right answer at his fingertips because his engineering staff has the technical know-how to solve any problem. When you call your Moline man, you know you're talking to an expert and you can rely on his advice and knowledge.

He offers experienced technical help to give you special service.

Most Moline distributors have been in business for many years and have an array of qualified technical men—machinists, gear cutters, installation crews and maintenance men—to help you with special service when you need it.

He maintains a diversified stock of power transmission equipment.

You'll save precious time when you call on your local Moline distributor for power transmission equipment. You don't have to shop around because he normally carries in stock components of every description. His inventory includes bearings, reducers, clutches, couplings, pulleys, takeups . . . virtually any item needed for efficient power transmission.

Find Us Fast In The 'Yellow Pages'

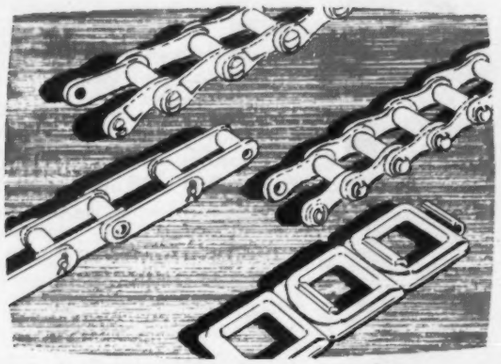
Moline Chains

Leaders for 60 years

for conveying, elevating and power transmission

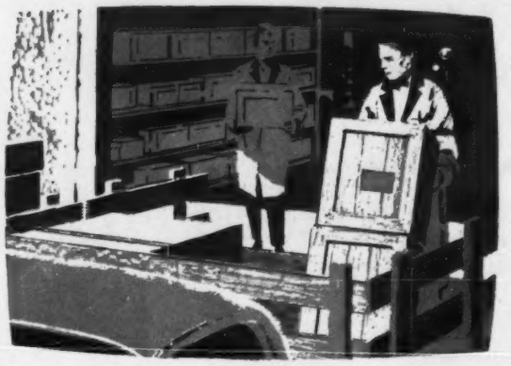
MOLINE MALLEABLE IRON CO., St. Charles, Illinois

Distributor than "order taker" service...



He carries a large stock of Moline chains, sprockets and buckets.

Your Moline distributor can supply you immediately with chain, sprockets, buckets, sheaves and attachments for any industrial conveyor, elevating or power transmission application. He is always available for help when you need "specials" in malleable chain and attachments because Moline has long been a prime source for OEMs when special chain is required.



He stands ready to give you immediate delivery from stock.

You can rely on fast service when you call your Moline distributor. Tremendous inventories on hand (many distributors stock up to 7,000 power transmission and conveying items) enable him to fill orders and have them on their way within 24 hours. So depend upon your Moline distributor for all your power transmission and conveying supplies and be sure of conscientious service and quality products.

Call your local Moline Chain Distributor today!

ALABAMA, Montgomery, Alabama Bearings Co.; Standard Elect. Mach. Co.; Mobile, Bearing & Trans. Sup., Turner Sup. Co.; Decatur, H & H Sup. Co.; Birmingham, Industrial Sup., Inc.; Sheffield, Martin Sup. Co.; Brewton, Pensacola Mill Sup. Co.

ALASKA, Ketchikan, Northern Mach. Works, White Motor Co.; Sitka, Sitka Engine & Equip. Co., Wrangell, Wrangell Mach. Works.

ARIZONA, Flagstaff, Arizona Sup. Co.; Phoenix, Seamon Bearing Co.; Tucson, Seamon Bearing Co.

ARKANSAS, Little Rock, Allied Arkansas Bearing Co., Mill & Mine Sup. Co.; El Dorado, American Sup. Co.; Pine Bluff, Arkansas Mill Sup. Co.; Fort Smith, Boal Fdry. & Mach. Co.; West Helena, A. S. Kelly Co.

CALIFORNIA, LOS ANGELES, J. W. MINDER CHAIN & GEAR CO.; SAN FRANCISCO, CHARLES A. FOWLER CO.; Fresno, Gordon Equip. Co., George M. Philpott Co.; North Sacramento, Fred E. Barnett Co.; Stockton, Stockton Bearing Co.; Stockton Iron Works, Standard Iron Sup. Co.; Lynwood, Best Chain Co.; Crescent City, Crescent City Mach. Works; El Centro, W. H. Douthitt, San Leandro, Monarch Corp.; Hemet, Steve's Auto Parts; Arcata, Reliable Hardware.

COLORADO, Denver, Allen Bearings Sup., Power Trans. Inc.; Grand Junction, Bearings & Power Trans.

CONNECTICUT, Waterbury, Valley Mill Sup. Co.

DELAWARE, Wilmington, J. C. Bennington Co.; Georgetown, Hemco Dist. Co.

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HAWAII, Honolulu, P. S. Pell Co., Ltd.

IDAHO, Boise, Western Bearings, Inc., Yanke Mach. Shop & Sprocket Co., Inc.; Pocatello, Flaherty Sales Inc.; Wallace, Coeur D'Alenes Co.

ILLINOIS, CHICAGO, HOLMES & JOHNSON, INC., Chain Sales, Inc., Baran Gear & Trans., Patlyn Gear & Trans. Co., Power Trans. Eq., Republic Bearing & Trans.; Rockford, Berry Bearing Co.; Aurora, Foy Sup., Industrial Sup. Co.; Fairfield, Mid East Sup. & Mach. Co.; Carpentersville, Northern Illinois Sup. Co., Inc.; Woodstock, T. M. Schultz Co.; Streator, Streator Industrial Sup.; Peoria, Hagerty Bros.

INDIANA, Terre Haute, B. F. Crawford Co.; Goshen, Day Equip.

IOWA, Fort Dodge, Fort Dodge Mach. & Sup. Co.; Des Moines, Globe Mach. & Sup. Co.; Davenport, Globe Mach. & Sup. Co.; Spencer, Globe Mach. & Sup. Co.; Cedar Rapids, Globe Mach. & Sup. Co.; Sioux City, Standard Bearings Co.

KANSAS, Wichita, B.R.C. Bearing Co., Inc.; Coffeyville, Kansas Bearing Sup.

KENTUCKY, LOUISVILLE, FRED WEMLE, Albert B. Crush & Co., Butler Sup. Trans. Co., Louisville Mill Sup. Co.; Hopkinsville, Cayce Mill Sup. Company.

LOUISIANA, Alexandria, American Sup. Co.; New Orleans, Atlantic Gulf Sup. Co., C. T. Patterson Co., Service Sup. & Engr. Co.; Lake Charles, Behrings Bearing Service of La.; West Monroe, Colossus Midland Belting & Sup.; Shreveport, Colossus Industries Inc., Midland Belting & Sup.; Baton Rouge, Louisiana Bearing Co.

MAINE, Bangor, Snow & Nealley.

MARYLAND, Baltimore, L. A. Benson Co.; Hagerstown, Hagerstown Equip. Co.

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MINNESOTA, HOPKINS, R. L. ACTON & ASSOCIATES; Fergus Falls, Empire Sup. Co.; Thief River Falls, Falls Sup. Co., Minneapolis, Industrial Sup. Co., Inc., Lakeland Engr. Equip., Minnesota Bearing; Austin, Powerite Elec. Motor.

MISSISSIPPI, Jackson, Harper Fdry. & Mach. Co., Mississippi Fdry. & Mach.; Greenville, Jackson Sup., Inc.

MISSOURI, KANSAS CITY, DAVID M. BOATRIGHT, S. D. Calloway Co. Inc., Industrial Bearing & Trans. Co., Noelling Steel Sales Corp., Kansas City Rubber & Belting, Lebanon Sup. Co.; St. Joseph, Wildhagen Mach. & Sup.; **ST. LOUIS, JAMES B. FLAHERTY,** Missouri Elec. Sales & Serv., R. J. Bearing Corp., Carter-Ryco Sales, Inc.; Springfield, Acme Fdry. & Mach. Co.

MONTANA, Great Falls, Carl Weissman & Sons; Missoula, Power Trans.

NEBRASKA, Omaha, Edw. J. Hech & Sons Co., Omaha Gear & Parts; Grand Island, Kelly Sup. Co.

NEVADA, Las Vegas, Reliable Bearing & Sup.

NEW JERSEY, Plainfield, R. M. Barwise, Inc.; Fair Lawn, Service Power Trans. Co.; Trenton, Tranton Bearing Co.

NEW MEXICO, Albuquerque, Harry Cornelius Co.

NEW YORK, New York, R. M. Barwise, Inc., Cangro Trans. Co.; Troy, Bearing Distrs.; Rochester, H. M. Cross & Sons; Bronx, Duane Trans. & Equip. Corp.; Riverhead, Eastern Welding Co.; Hicksville, Long Island Trans. Co.; Buffalo, Mey Chain Belt Co., Power Drives, Inc.; Syracuse, Sawyer Engr. Co., Syracuse Bearing; Albany, Transmatic Equip. Co.; Elmira, Harold Van Ausken Mill Sup.; Lockport, Ward Bros. Mill Sup. Co.

NORTH CAROLINA, Lenoir, Blue Ridge Hardware & Sup. Co.; Statesville, Bryant Sup. Co., Tri-State Distrs., Inc.; Gastonia, Bryant Sup Co., Gastonia Mill Sup. Co.; Rocky Mount, Carolina Mach. & Sup. Co., H & S, Inc.; Kinston, Carolina Mach. & Sup. Co.; New Bern, Craven Fdry & Mach. Co.; Mount Airy, Currier-Withers Sup. Co.; Raleigh, Elect. Equip. Co., Wilmington, General Sup. Co., Mill & Contractors Sup. Co., Wilmington Iron Works; Lexington, General Trans. Sup.; Roanoke Rapids, Industrial Distrs. Inc.; Charlotte, Industrial & Textile Sup. Co., Henry Walke Co.; High Point, Kester Mach. Co.; Winston Salem, Kester Mach. Co.; Greensboro, O'Dell Mill Sup. Co.; Shelby, Shelby Sup. Co., Inc.; Burlington, Sykes Sup. Co.

NORTH DAKOTA, Fargo, Empire Sup. Co.; Jamestown, Empire Sup. Co.; Bismarck, Empire Sup. Co.; Grand Forks, Grand Forks Sup.; Minot, Minot Sup. Co.; Williston, Williston Sup. Co.

OHIO, Cincinnati, Cincinnati Trans.; Cleveland, C. J. Edwards Co.; Toledo, Gear Prod. Co., Toledo Belting & Sup.; Columbus, White-Orr Co.; Canton, Wilkof Indust. Sup.

OKLAHOMA, Tulsa, Allied Bearings Sup., Clark Bearing & Sup. Co.; Chickasha, Chickasha Gin & Mill Sup.; Oklahoma City, Dagwell-Dixie Co., Equipment Sales, Power Equip. Inc.; Muskogee, Pate Indust. Sup.

OREGON, PORTLAND, J. W. MINDER CHAIN & GEAR CO.; Medford, Cal-Ore Mach. Co., Inc.; Eugene, Electric Steel Fdry. Co.; Astoria, Fisher Bros. Co.; North Bend, Industrial Steel & Sup. Co.; Salem, Mill Sup. Co., Grant Pass, Pacific Logging & Mill Sup.

PENNSYLVANIA, ARDMORE, JOHN A. SNOEMAKER; Philadelphia, D. P. Brown Co., Inc., Rodney Davis Gear Co., Lindsay-Oberholzer & Co., Rothman Equip. Co.; Harrisburg, Industrial Motor Sup. Co.; Hazelton, Industrial Sup. Co.; Allentown, Keystone Bearing & Sup.; Pittston, Medico Industries Inc.; Pittsville, Chas. C. Morris Co.; Lancaster, Reilly Bros. & Raub; Scranton, Sherwin Bearing Co.; Muncy, Sprout Waldron & Co.;

PITTSBURGH, CHARLES R. SIMMONS, Banbury Equip. Corp., Hartley-Rose Co., Ritter Engr. Co.; New Kensington, Burrell Indust. Sup.; Ridgway, North American Indust. Sup. Inc.; Uniontown, Tri-State Mine Sup. Co.

RHODE ISLAND, Providence, James A. Starck.

SOUTH CAROLINA, COLUMBIA, THOMAS S. GLAZEBROOK, Columbia Sup. Co., Thackston-Davis Sup. Co.; Greenville, Carolina Sup. Co.; Charleston, Charleston Sup. Co.; Spartanburg, Crawford Mill Sup. Co., Noland Co., Inc.; Rock Hill, Manufacturers' Sup. Co.; Florence O'Brian -Mace Co.; Anderson, Seabrook Trans. Co.; Orangeburg, J. M. Smoak Hardware Co.; Summerville, Southern Mill Sup. Co.; Sumter, Sumter Mach. Co.

SOUTH DAKOTA, Sioux Falls, Western Bearing & Sup.

TENNESSEE, MEMPHIS, MALCOLM S. CONE CO., Dabney-Hoover Sup. Co., Lewis Sup. Co.; Nashville, Industrial Sales Co., Inc., Keith-Simmons Co., Inc.; Jackson, Motor Parts & Bearing Co.; Chattanooga, Noland Co., Inc., Volunteer Bearing & Trans.; Knoxville, Browning Belting & Sup. Co., Industrial Belting & Sup. Co., W. Savage Co.

TEXAS, DALLAS, R. C. BROWN CO., Allied Belting & Trans. Co., Bearings & Power Trans., Briggs Weaver Mach. Co., Coastal Plains Sup. Co., Engineering Sup. Co., Texas Rubber Sup.; Lubbock, Bigham Gin Sup. Co., Consolidated Gin & Sup., Industrial Sup. Specialists, M. B. McKee Co., Bearing Specialists; Fort Worth, Con El Sales & Engr. Co., General Indust. Sup., Great Western Sup. Co., Hall Bearing Co., Welsco Co.; Conroe, Conroe Mill Sup. Co.; Tyler, Coffingham's Inc.; Longview, Coffingham's Inc., Herritage Tool & Sup.; Plainview, Diamond Indust. Sup.; Houston, Diamond Sup. Corp., Hou-Tex Sup. Co., Texas Belting & Mill Sup.; Brownsville, Gilbert Bearing Service; Asmarillo, A. D. Gugenheim Co.; Sherman, Hardwicke-Etter Co.; McAllen, A. M. Hassell Sup. Co.; Marshall, E. B. Hayes Mach. Co.; Lufkin, Lufkin Fdry. & Mach. Co.; El Paso, Midcap Bearing Co., Patterson Sales Co.; Pecos, Navarro Sup. Co.; Waco, Richards Equip. Co.; Orange, Sabine Sup. Co.; Wichita Falls, Wichita Bearing Co.

UTAH, Salt Lake City, All Trans. Prods., Power Trans. Sup.

VERMONT, St. Johnsbury, Reed Sup. Co.

VIRGINIA, Bassatt, Blue Ridge Hardware & Sup. Co.; Martinville, Blue Ridge Hardware & Sup. Co.; Lynchburg, J. C. Ferebee Co., Ferebee-Johnson Co., Inc.; Roanoke, Graves Humphreys' Inc.; Waynesboro, Mize Sup. Co.; Petersburg, Tom Horton Co.; Richmond, Southern Railway Sup. Co.; Norfolk, Taylor Parker Co., Henry Walke Co.

WASHINGTON, SEATTLE, CHAIN GEAR, INC.; Spokane, Empire Bearing Co., Nott-Atwater Co.; Everett, Greenshield's Indust., Power Trans. Sales; Tacoma, Reel Mach. Co.; Bellingham, Schuman Steel Prod. Inc.; Mount Vernon, Trans-Bearing Co.; Longview, Longview Equip.

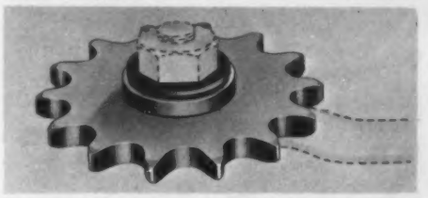
WEST VIRGINIA, Bluefield, Bluefield Hardware Co.; Charleston, Capital City Sup. Co.; Logan, Guyan Mach. Co.; Elkins, Valley Mill Sup. Co.; Huntington, Wall Conveyor & Mfg. Co., Banks-Miller Sup. Co.

WISCONSIN, Green Bay, Libert Bearing; Madison, Richard E. Ela Co.; Wausau, Sjoberg Indust. Sales; Milwaukee, Equipment Specialty Co.

CANADA, Vancouver, Victoria, Western Equipment Ltd.; British Columbia, Bennetts Ltd., Okanagan Equip. Ltd.; Alberta, Electrical Ind. Ltd., Electrical Cont. & Mach. Co. Ltd., Oliver Chem. Co. Lethbridge Ltd.; Saskatchewan, Bearing & Trans. Supply, Tractor Repair Parts Co.; Manitoba, Cuthbert Co. Ltd.

Circle 44 on Reader-Service Card for more information

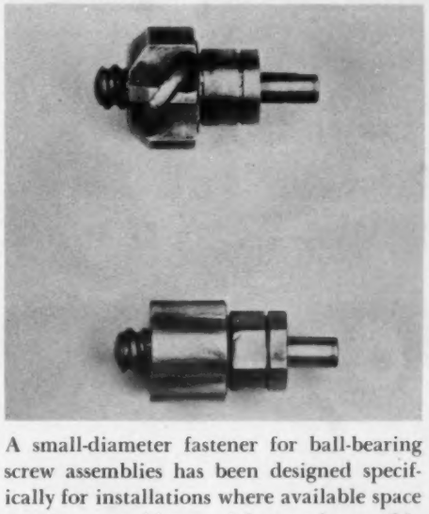
Idler Sprockets 314



Unimount idler sprockets are bearing-equipped and fully assembled to simplify procurement and installation on all types of equipment using roller chain drives. The low-cost units provide high quality and durability. The oil-impregnated bearing is a press fit in sprocket bore and a slip fit over the steel journal to eliminate "run out". Steel journal is case-hardened to insure longer service life. Steel washers are a press fit over steel journal to complete assembly and provide proper lateral clearance between working parts.

Diamond Chain Co., Inc., 402 Kentucky Ave., Indianapolis 7, Ind.

Compact Ball-Bearing Fastener 315



A small-diameter fastener for ball-bearing screw assemblies has been designed specifically for installations where available space presents a problem and has made possible many new applications in minute actuator units. On the screw assembly shown at the lower half of the illustration, OD of the nut has been reduced 20 percent—from 0.500 to 0.400 inch. This assembly has a ball circle dia of 3/16 inch and is fitted with balls only 1 mm in dia. The compact design of the nut eliminates need for the conventional return tube.

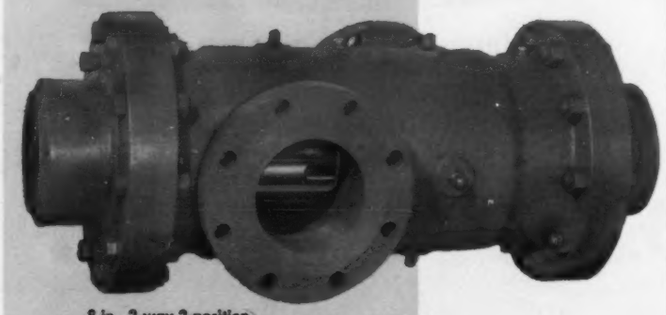
Saginaw Steering Gear Div., General Motors Corp., Saginaw, Mich.

BIG

2 in., 3-way 3-position, double solenoid type.

CONTROL VALVES

up to 8 in. • 5000 psi



8 in., 2-way 2-position, double pilot cylinder type.

Need more flow capacity than you can get with the largest sizes available in most valve lines? There's an easier answer than resorting to costly multiple valving, or redesigning your system to suit flow limitations.

Hunt builds valves in sizes up to 8 in., with air flow ratings of *more than 32,000 cfm* @ 100 psi pressure drop! In fact, you can choose from valves ranging in size from ⅛ through 8 in.; 2 and 3-way, 4-way 2 or 3-position; solenoid, remote-pilot or mechanically actuated; with a variety of optional mountings and features.

If control of large volumes of air, oil, water, or soluble oil and water at pressures up to 5000 psi hyd. is one of your requirements, it'll pay you to talk to your Hunt representative. His specialized knowledge can save you hours and dollars. Call him today.

HUNT

QUICK-AS-WINK© AIR AND HYDRAULIC

VALVES

HUNT VALVE COMPANY • DIVISION OF IBEC • SALEM, OHIO

For more information, write for Bulletin 603. Address Hunt Valve Company, Salem, Ohio, Dept. DN-661.

3020

Circle 45 on Reader-Service Card for more information

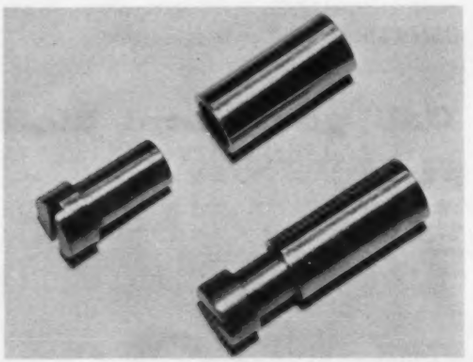
FHP Motors 316

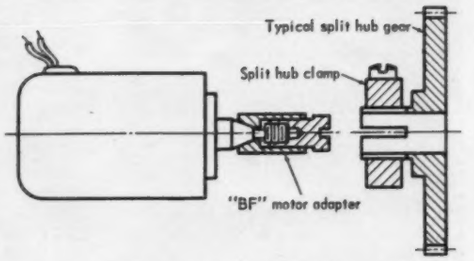
Subfractional horsepower motors are available in two models. Model "L", a 117v shaded-pole induction motor, is designed specifically for typewriters, business machines and similar equipment demanding high torque, compact design and low cost. It may be obtained with or without clutch. Model "H" features high starting torque combined with compact size, making it suited to gear trains, air circulation, remote controls and other applications.

Alliance Mfg. Co., Dept. MJ, Alliance, Ohio.

Precision Shaft Adapters 317

An improved series of shaft adapters has been designed to convert tapered or odd-dimensioned motor shafts to the use of ¼-inch standard-bore gears or couplings. Machined from 303 stainless steel, with clear passivate finish, the two-piece





adapters provide a 0.2497 (+0.000; −0.002 inch) standard shaft on tapered-shaft motors, such as Diehl FPE-25 and FPE-49 and Bureau-of-Ordnance-type rotating components, such as synchros, resolvers and tachometer generators.

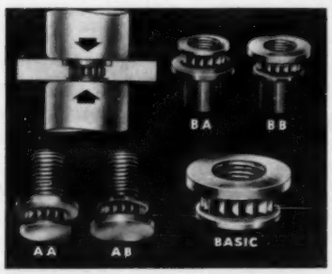
PIC Design Corp., 477 Atlantic Ave., East Rockaway, Long Island, N. Y.

Self-Locking Fasteners 318

High pressure, self-sealing fasteners now can be obtained with a resilient nylon pellet embedded in threaded area for added reliability and thread-locking action. This feature supplements the locking action of the O-ring under fastener head and provides increased protection against shock and vibration. This locking action has been approved by all services under MIL-F-18240 specifications in tapped holes, in place of locked-wire screws and bolts. "Seelskrews" with inserts are furnished in stainless steel with silicone-rubber O-rings, in either slotted-head or Phillips-head construction.

A.P.M. Corp., 41 Honeck St., Englewood, N. J.

Flush-Mounted Fasteners 319



Pressure displacement fasteners are designed for installation into ductile material using standard punch-press procedures. Fasteners are installed by pressing the large flange into ductile sheet. Displaced material forms into the knurled undercut. Types BA and BB (self-locking appendages) and the basic flush-mounted fasteners are rated at 550F. Types AA and AB studs withstand temperature extremes of 550F. BA and BB types meet requirements of MIL-N-25027. Fasteners are available for sheet thicknesses of 0.040 through 0.180 inch and in thread sizes ranging from 2-56 through ¼-28.

Stake Fastener Co., 1710 Potrero St., South El Monte, Calif.

Circle 46 on Reader-Service Card

NICKELOID IS EVERYWHERE

These eye-catching products use functionally a basic Nickeloid Metal. The finish of Chromium, Nickel, Brass or Copper is electroplated to a base metal, usually Steel (but often Zinc, Brass or Copper).

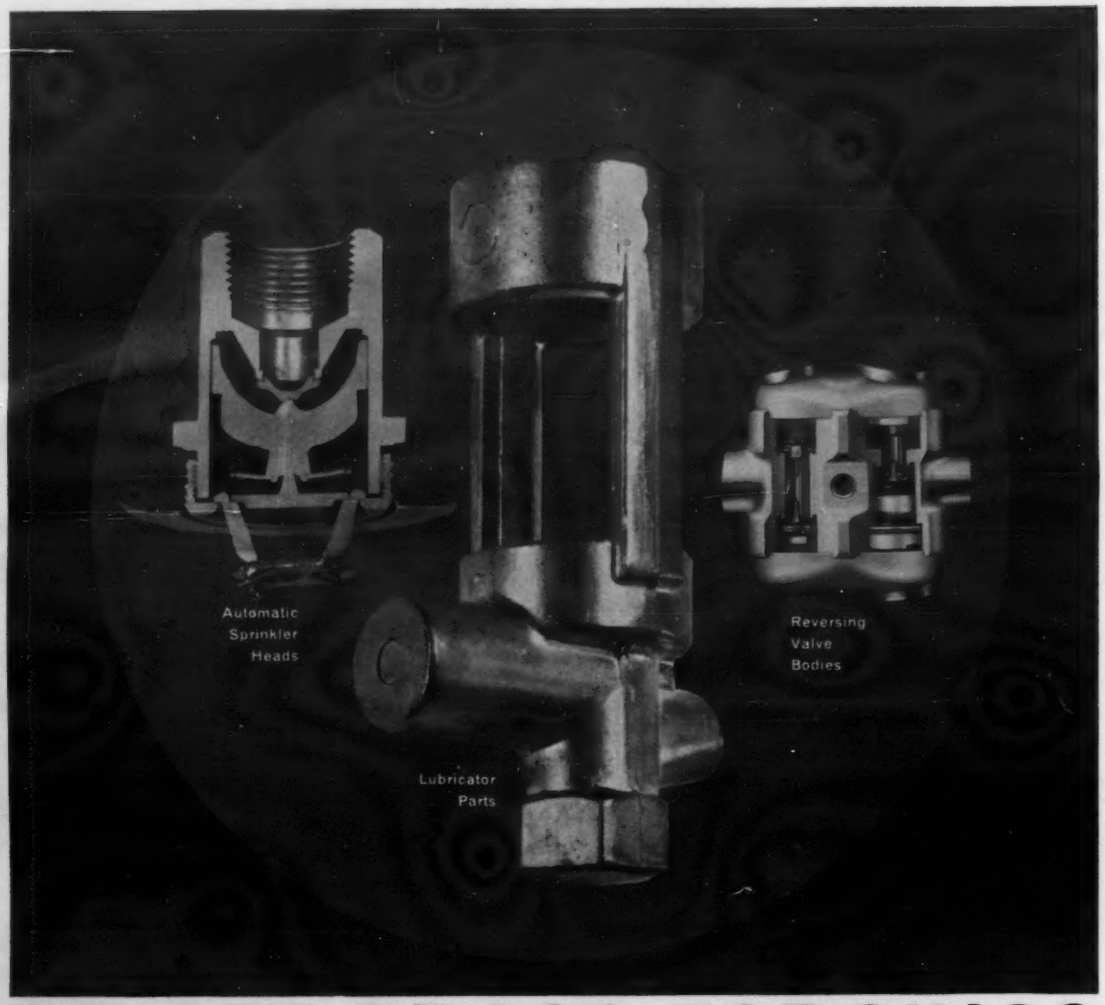
Mostly, Nickeloid Metals are supplied in continuous coils in widths up to 24" for modern, low cost fabrication. They're also available in sheets and strips. Optional: bright or satin finishes, plating one or both sides, a galaxy of stunning patterns and crimps.

Quality plating produces metals so durable they can be fabricated, even quite severely drawn or bent. Rejects minimized. For severe stamping, we offer Mar-Not protective coating that is easily peeled off after its job is done.

Which is your preference in modern metals — the clean, flint-hard gleam of Chromium, the warmth of Copper, or the rich radiance of polished Brass? No need to answer now; but consider the galaxy of wonderful products you find everywhere today that employ one of the Nickeloid Metals. These durable, lustrous finishes are not mere lily-gilding. In most instances they are designed INTO the product . . . functionally. We make a raw material that has been given these quality finishes the *automated* way . . . in giant coils in block-long mills. Nickeloid finishes are electroplated to the base metal *before fabrication*, a process as fundamental we believe as the coating of printing papers in rolls *before they are printed*. Three out of five costly manufacturing steps are by-passed. Write for our free Introductory Kit, which includes metal samples — learn the complete story.

AMERICAN NICKELOID COMPANY · PERU 9, ILLINOIS

America's Pioneer Manufacturer of Pre-Finished Metals — Since 1898



REVERE BRASS FORGINGS

BETTER PARTS...LOWER UNIT COST...FEWER REJECTS

Here are three of the thousands of sub-assemblies that have been converted from castings to Revere Die-Pressed Forgings by their manufacturers. Design men and production staffs alike have found that the switch to forgings means better parts, at lower cost-per-unit and with fewer rejects.

Reasons for these:
Forgings permit manufacture to closer tolerances, with far less machining and finishing, compared with castings.

Die-pressed forgings eliminate sand holes, pits and rough spots that cause frequent rejects of castings.

Smooth, dense surface of forgings takes a better plating finish compared with castings.

The Revere Technical Advisory Service is ready to work with you to help you take advantage of the benefits of a switch to forgings—in brass, copper, other copper alloys and aluminum. Send us the part you make or your drawings for initial recommendations. For further details, you can reach this helpful knowledge and experience by calling the nearest Revere Sales Office.

SEND FOR THIS HELPFUL BOOKLET
"Revere Forgings: Aluminum • Brass • Copper"
Rome Manufacturing Company Division
Box 111, Rome, N. Y.

REVERE
COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
Executive Offices: 230 Park Avenue, New York 17, N. Y.
Mills: Rome, N.Y.; Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles, Riverside and Santa Ana, Calif.; New Bedford and Plymouth, Mass.; Brooklyn, N.Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities.
Distributors Everywhere.

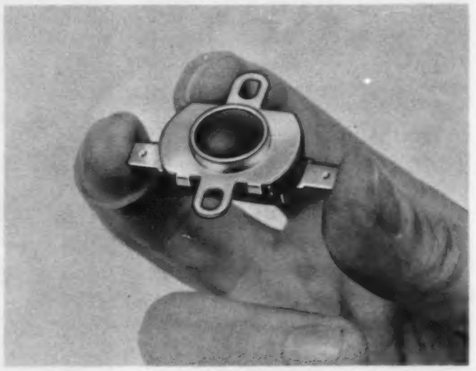
Circle 47 on Reader-Service Card for more information

Insulated Thermostat 320

The Model BH thermostat is useful where application dictates the minimum differential consistent with the smallest size. Similar in construction to the Model DR, the unit features longer bimetal actuated contact, making possible a maximum differential of less than 0.5C. The case is insulated by means of two glass-seal solder terminals. Units can be supplied with custom-designed mounting brackets. These can be calibrated and hermetically sealed at the factory or by the customer.

Chatham Controls Corp., 149 River Rd., Chatham, N. J.

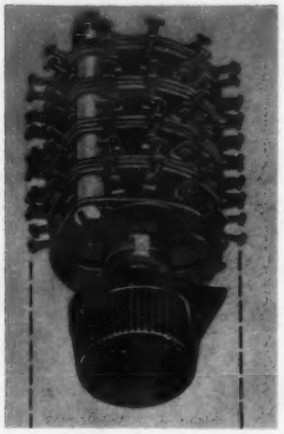
Bimetal-Disc Thermostat 321



The high-capacity, bimetal-disc thermostat is designed to fill the space limitation requirements of the baseboard heat industry, plus those of many other applications. This low-cost, snap-action device is UL listed for accurate repeatability over 100,000 cycles at 350F for 10 amps resistive, or ⅛-hp inductive at 120/240v a-c. The regulating device is obtainable with enclosed or exposed bimetal disc and various mounting flanges and terminal arrangements.

Therm-O-Disc, Inc., Mansfield, Ohio.

Subminiature Rotary Switches 322



Low-current installations such as test equipment, geophysical apparatus, airborne and transistorized instruments are applications of the Series 7000 and 5000 rotary switches. The 7000 series provides a full 12 live-switching contacts per deck through a triple-wafer design with rotor contacts on front and switching contacts on rear of same deck. Series 5000 has the same wafer design and provides twice the switching capability per deck with up to 12 contacts on front and 12 contacts on rear of the same dual-duty deck. Positive 30-deg indexing is provided through a snap-action detent which accelerates rotation at breaking time to reduce arcing, increase contact life and avoid hangups. Indexing of 60 and 90 deg also may be obtained. Deck wafers are epoxy-glass fabric laminations per MIL-P-18177 (ships). Deck rotor is "Steatite Grade L-4" treated with DC-200, meeting MIL-I-10A; wafer contacts are 90-percent silver alloy, double wiping for low contact resistance and self cleaning. All wafer contacts are gold plated. Frame, detent mechanism and shaft are stainless steel. Both series are offered in shorting or nonshorting types; in lever types, and in spring-return lever and rotary types.

J-B-T Instruments, Inc., 133 Hamilton St., New Haven 8, Conn.

Circle 48 on Reader-Service Card

NEW FAST DRAW TECHNIQUE CUTS FABRICATING COST OF MAGNESIUM

Magnesium parts are now being deep-drawn experimentally at high speeds with a newly-developed process. It uses standard mechanical presses, moderate temperatures (400°F.) and ordinary soap-type lubricants. The part illustrated below was drawn and ejected in 1½ seconds.

This technique cuts the cost of fabricating cylindrical parts of magnesium—with its unparalleled combination of light weight, stiffness and strength. Draws to a 50% reduction are made readily at normal production speeds with a minimum of die stages.

The new technique is expected to find use for many drawn magnesium parts, including components of appliances and business machines. Find out what it can do for you. Write THE DOW METAL PRODUCTS COMPANY, Midland, Mich., Merchandising Dept. 1109AV6-5.

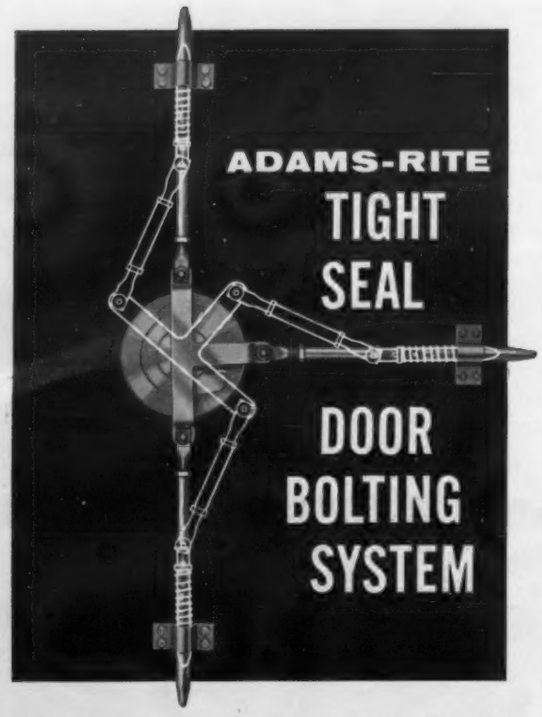
FROM BLANK...

TO PART...

IN 1½ SECONDS CYCLE TIME

DOW THE DOW METAL PRODUCTS COMPANY

Division of The Dow Chemical Company



FOR POSITIVE CLOSURE

ADAMS RITE multiple-bolt systems are designed for use on doors and panels which must be secured at more than one point. They are of particular value on doors or hatches which must be closed with a POSITIVE seal to prevent the entrance or escape of moisture, air or gas. Environmental chambers, electronic equipment, pressurized testing units, and paint spray booths are a few of the applications where these A-R systems have proven themselves.

ADAMS RITE has been manufacturing precision mechanical products for over 50 years and is the major supplier of door hardware for the aircraft industry. A-R products are Designed for a Purpose and include locks, latches, handles, door bolting systems, tie-down fittings, and mechanical controls. Products for specialized applications are designed and manufactured to customer specifications.

AVAILABLE WITH:

FLUSH HANDLE

LOCKING HANDLE

NON-LOCKING HANDLE

Write for complete information or latest file catalog of descriptive literature. Dept. A-2

"Over half a century"

ADAMS RITE
MANUFACTURING COMPANY
540 West Chevy Chase Drive
Glendale 4, California

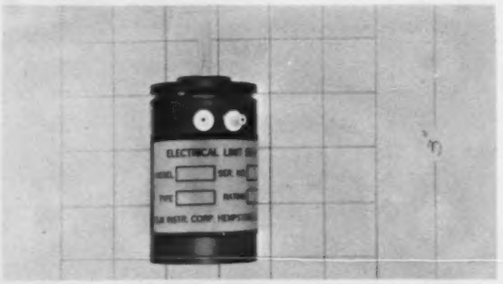
Circle 49 on Reader-Service Card for more information

Miniature Switches 323

New forms have been added to this line of miniature, oiltight, industrial pushbuttons to provide additional flexibility for users of space-saving units. The new electronic components include a wobble-stick operator; bat-lever selector switch; coin-operated selector switch, and cylinder-lock selector switch. Separable operators, contact blocks, rings, selector-switch knobs, illuminated forms and color caps are offered to give the extra flexibility of building-block construction. Miniature pushbutton line provides savings of up to 40 percent in panel space requirements. Rings, buttons and selector knobs are available in a tough plastic that allows maximum flexibility in color coding, color permanence and attractiveness. Buttons and selector-switch knobs are also available with bright metallic operators.

General Electric Co., Schenectady 5, N. Y.

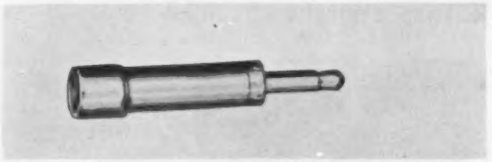
Limit Stop 324



An electrical limit stop features terminal selectivity, low starting and running torque, and additional use as a rotary switch. Contact in individual or combinations of turns, degrees or minutes can be selected. The rotary component, coupled with a slip clutch or similar unit, provides protection when used as a rotary switch to close circuits. Model ELS-100 is available in sizes 5 to 18. The size 10 unit measures 1¾ inches in overall length with a 1.0-inch dia. To prevent internal shorting, a high-temperature phenolic case is used. All contacts are from a common leg, with contacts and slip rings made of high-grade silver.

Elm Instrument Corp., 30 Chasner St., Hempstead, Long Island, N. Y.

Phonojack Adapter 325



This device meets the needs of hobbyists, audiophiles, service dealers, sound contractors and "hams" in situations when a connecting cord ends with a phono plug and female connection is a "Tini-Jax". The No. 370 has "Tini-Plug" (tip 9/64 inch dia by 9/16 inch long) finger output to phonojack input. The unit has nickel-plated, completely shielded, straight-through connections, tip to tip, body to body.

Switchcraft, Inc., 555 N. Elston Ave., Chicago 30, Ill.

DPDT Switch Light 326

This miniaturized DPDT snap-action switch light has builtin lead-lag zeroing. All components are contained in one compact anodized-aluminum case. A simple screwdriver adjustment, before or after installation, allows the user to easily zero the switch at both poles for simultaneous switching. Designated 6BR, the unit is designed for application where two switching functions are required, combined with an independent but logically related lamp indication. Color coding is provided by non-rotating pushbutton lenses in all standard clear or translucent colors. The snap-on lenses provide both front and side illumination. Guaranteed for 25,000 operating cycles at 28v d-c with 7-amp resistive load the device is designed to meet all applicable military specifications. Lamps for the unit are standard 2-pin plug-in with operating voltages from 5 to 28v d-c. Optional series resistors, potted and self-contained within the lamp base, are available to extend lamp life.

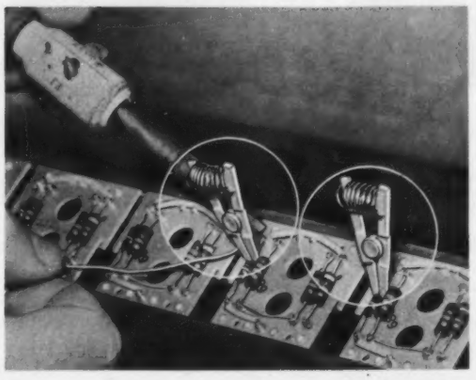
Eldema Corp., 1805 Belcroft, El Monte, Calif.

Brookside's fans and blowers will supply *your* product with unvarying performance and dependability. Constant quality checks . . . 12 inspection points . . . and rigid final inspection guarantee Brookside fans and blowers to perform *beyond* your specified requirements. A wide range of models is available or we will supply custom engineering free of charge, along with truly *personal* service. Let Brookside Corporation solve your next air-moving problem with a collect call to EDison 5-2101, McCordsville, Indiana for an appointment with a Brookside sales/engineer or field engineer.

Brookside
CORPORATION
McCORDSVILLE, INDIANA • TELEPHONE EDISON 5-2101
MANUFACTURERS OF FANS • BLOWERS • AIR MOVING EQUIPMENT

Circle 51 on Reader-Service Card for more information

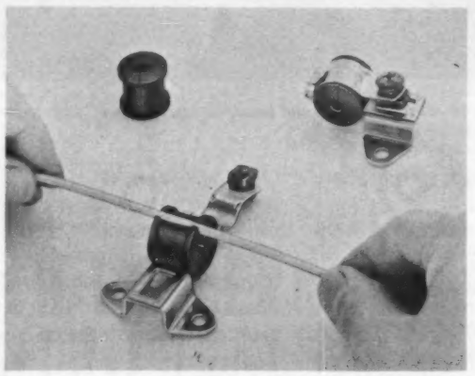
Heat-Sink Clip 327



Semiconductors can be protected during soldering phase on an electronic assembly with the aluminum heat-sink clip. It fits around wire running between semiconductor and joint to be soldered, and during soldering operation it absorbs and dissipates heat that runs along wire toward semiconductor. Clips are easy to use on assembly operations and can effect important savings in reducing assembly time and costly rejects.

Avtron Mfg., Inc., 10409 Meech Ave., Cleveland 5, Ohio.

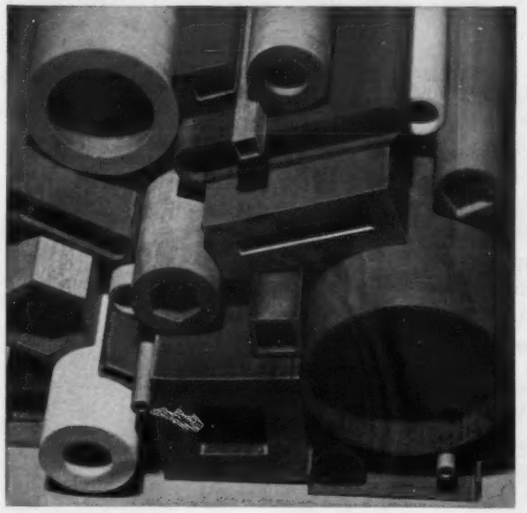
Quick-Disconnect Harness 328



Tube and wire diameters as small as 1/8 inch can now be harnessed with this small-diamater "Flip-Loc" clamp. A molded insert insulates and cushions the tube or wire and permits fast access by means of the hinge and quick-detach key-nut fixture. This saves time and cost in initial assembly of small wires and tubes. The resilient insert offers a complete 360-deg grip and prevents any pinching or chafing of tube or wire. Insert is available in either neoprene or aromatic fuel-resistant material. Special insulating materials are obtainable on special order.

TA Mfg. Corp., 4607 Alger St., Los Angeles 39, Calif.

ALL Your Needs in Laminated Plastic Tubes



An Example of
Synthane *You-shaped* Versatility

At Synthane we have the versatility to give you just about everything you want in laminated plastic tubing or parts. Over 25 standard grades including those complying with governmental specifications. Sizes 3/32" ID up to 26 1/4" OD. Lengths 18" to 96". Wide range of wall thicknesses. Selection of colors and finishes. Molded and rolled tubing. Variety of cross sections—round, oval, square, polygonal, etc. Our excellent fabrication facilities provide you with finished parts to your specifications.

You-shaped Versatility makes Synthane a Better Buy in Laminates

SYNTHANE CORPORATION OAKS, PENNA.

Synthane Corporation, 6 River Road, Oaks, Pa.
Gentlemen:
Please send me information about Synthane as a source for laminated plastic tubes and parts fabricated from tubes.

Name_____

Address_____

City_____ Zone____ State_____

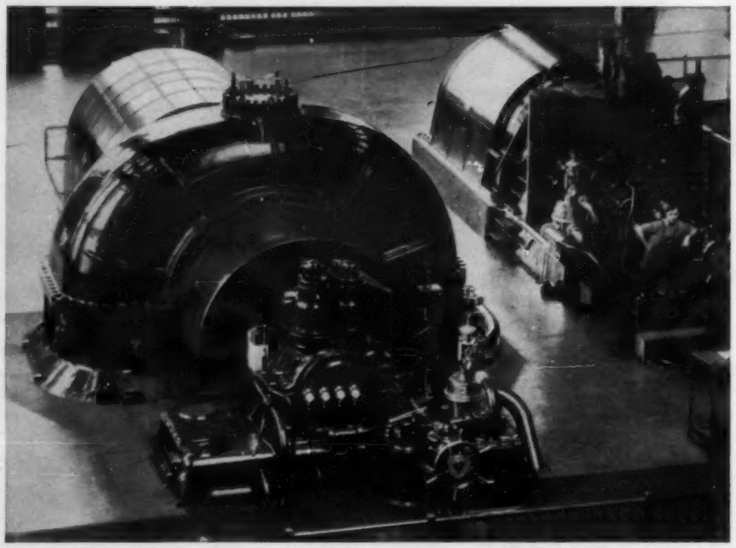
Circle 52 on Reader-Service Card for more information

TURBINES:

Shell reveals three ways that Turbo Oils help prevent oil breakdown, rust, sludge and foaming

Small quantities of air and water can work their way into any turbine lubrication system. These contaminants can accelerate oxidation of the oil.

Read how Shell scientists developed a specific formulation that counters this oxidation and brings you turbine lubricating oils with top performance records.



Shell Turbo Oils lubricate turbines with total rating of more than 17 million kw in the U. S. and Canada.

When oxygen attacks turbine oil, it can form peroxides and organic acids. A chain of oxidation reactions begins. If the oil stability is inadequate, sludge can form.

Air entrained in the oil can aggravate oxidation. And it may cause foaming.

The oil may also be affected by water in the system. Laboratory tests have shown that water can greatly accelerate an oxidation process.

With Shell Turbo® Oil, Shell tackles these problems in three key ways:

1. *Shell carefully selects base oils for use as turbine lubricants,* then refines them to get the most effective response to Shell's special additives.

2. *Shell adds a powerful oxidation inhibitor to its precisely refined base oils.* This inhibitor helps prevent the chain of oxidation reactions caused by oxygen exposure at operating temperatures. It helps keep the oil in good condition, and lengthens its service life.

The result is that Shell Turbo Oils have proved themselves unusually stable over long service periods.

3. *Shell uses an outstanding rust inhibitor.* As a protective measure, Shell uses special additives that cover metallic surfaces with strongly adherent polar-type films.

These films are designed to *help keep water from the metal surface.*

A message to manufacturers of turbine equipment

There are several grades of Shell Turbo Oil. One of them suits your equipment.

1. Your customers can get Shell Turbo Oils at Shell depots everywhere. Readily available throughout the world.

2. Quality is consistently high. Shell Turbo Oils always deliver top performance.

In drastically accelerated laboratory tests, metals immersed in Shell Turbo Oils show outstanding anti-rust performance—even in the presence of sea water.

Ask your Shell Industrial Products Representative for facts on Shell Turbo Oils. Or write: Shell Oil Company, 50 West 50th Street, New York 20, New York.

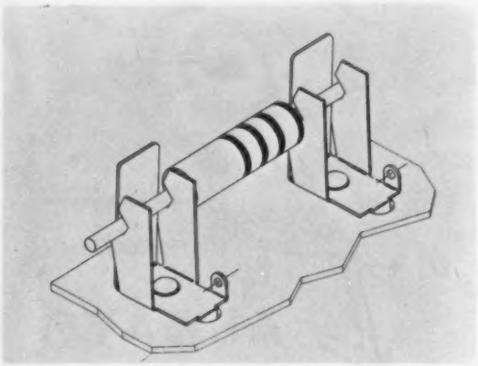
SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are working to provide better products for industry

Circle 53 on Reader-Service Card for more information

ELECTRICAL

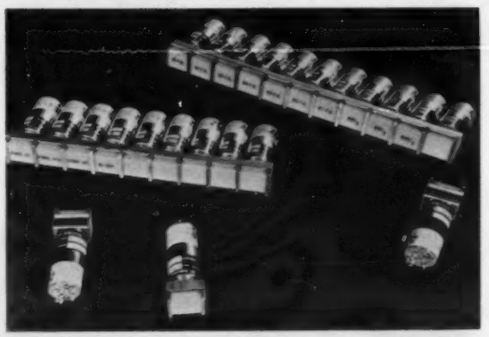
Component Holder 329



The "Quik-Loc" electronic component holder accommodates wire diameters from 0.005 to 0.063 inch. The device is for use with components such as resistors, condensers or diodes with wire pigtail leads. Simple design allows the easy insertion of wire lead, yet assures positive retention of lead under most severe conditions.

Augat Bros. Inc., 33 Perry Ave., Attleboro, Mass.

Ganged Lighted Switches 330

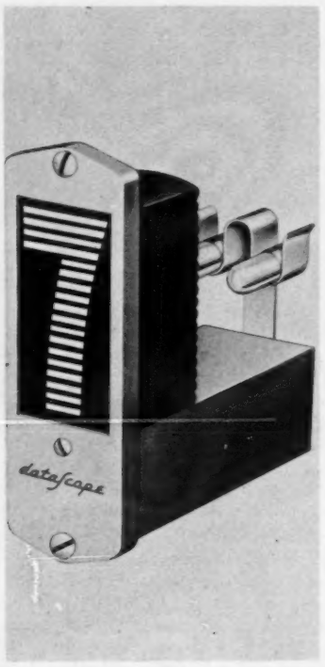


Direct panel-mounting switches are offered in combinations from 2 to 12 alternate-action or momentary units. Model 801P may be mounted on the same channel to fit individual customer requirements. Switches mount on 1-inch centers to improve panel appearance, to reduce required mounting space and to simplify installation. Mounting hardware reinforces cutouts in panel to nearly original strength for any number of units. Ganged units are obtainable single-pole through six poles.

Sloan Co., Color-Lite Div., 7704 San Fernando Rd., Sun Valley, Calif.

Self-Decoding Digital Readout 331

A miniature readout is offered as a complete package and mounts in a 1- by 3.1-inch panel space and extends only 2.5 inches behind panel. Instrument decodes either binary inputs or pulse trains and displays information in digital form. Sixteen ¾- by 1¼-inch alpha-numerical characters are displayed at any rate up to 50 characters per sec. Of the 16 symbols, 10 are the normal decimal digits and the other six are available to customer specification. Sealed construction, long life and light weight (only 4



oz) qualify this instrument for all types of military and commercial applications. Installation or replacement is accomplished quickly with the new front-panel mounting feature. Unit can be used singly for one-digit readout or gang-mounted to meet any required display sequence. Unit operates on either 12 or 28v d-c. Power requirements are 0.57 watt-second per bit.

Datascope Corp., 4023 Irving Pl., Culver City, Calif.

Circle 54 on Reader-Service Card

solve the processing puzzle WITH EASTERN CENTRIFUGAL PUMPS

In every detail of size, weight, space requirements, materials, power and costs, Eastern Centrifugal Pumps are made to match strict process requirements.

- **PRESSURES:** to 21 psi in single stage pumps; to 70 psi in multi-stage types
- **FLOWS:** capacities to 70 gpm in single-stage pumps, to 10 gpm for many multi-stage models
- **MOTORS:** standard motors for 115/230-volts 60 cycles 1 phase (other electrical characteristics available). Power range from ⅛ to 1½ H.P.
- **ENCLOSURES:** drip-proof, totally enclosed, and explosion-proof ball-bearing frames
- **DRIVES:** all models available in belt or coupling drive with ball-bearing equipped stands. Space-saving close-coupled pumps most rugged and popular — but many pedestal models also available
- **SEALS:** a variety of rotary seals and stuffing boxes, to fit every application
- **METALS:** your option of cast iron, bronze, stainless steel (18-8 type 303 and 316) Monel, Cast Iron, Hastelloy "C"
- **INSTALLATIONS:** a wide range of transfer, recirculation, feed, boost, and filter-pumping applications

TO FIND OUT: write for the brand-new Centrifugal Pump Catalog — Bulletin 130. Here are all the models — including useful engineering data.

For a complete review of positive displacement pumps for non-lubricating fluids, write for Bulletin 220. Eastern Bulletin 400 is your guide to a broad line of midget-centrifugal pumps and stirrers for the laboratory.

EASTERN INDUSTRIES, INCORPORATED

100 SKIFF STREET • HAMDEN, CONNECTICUT
West Coast Office: 4203 Spencer St. • Torrance, Calif.

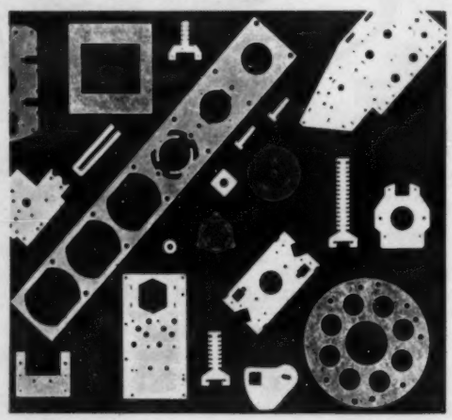
Other Eastern products: • hydraulic motors • gear pumps • positive displacement pumps • aircraft pumps

Dry Transfer Letters 332

A simple-do-it-yourself method allows the transfer of sharp and clear letters to any surface without the need for cutting and pasting. The translucent sheet contains the alphabet in reverse position. The sheet is placed face down in position on art, tracing, plastic, photo or any surface that requires lettering. Letters are rubbed lightly with a small paddle (supplied with sheet), transferring letter directly to art. Complete fonts from 90 to 400 characters per sheet offer a large variety of type faces and a wide range of point sizes in red, black, white, blue or gold.

Prestype, Inc., 136 W. 21st St., New York 11, N. Y.

Heat-Stable Laminate 333



A Class B electrical insulation that has outstanding retention of properties during and after heat has been added to the line of fiber-glass reinforced polyester lamintes. Grade TSA flat sheet stock is a low-priced material with properties that meet or exceed NEMA GPO-1 specifications. The 1/16- and 3/32-inch thicknesses cost only $0.65 per lb in quantities of 300 lb or more. The material has good dimensional stability under exposure to heat and moisture. It retains 100-percent impact strength, even after heat aging at 250C. Perpendicular dielectric strength retention is 75 percent after 200 hr at 150C. The laminate is offered in thicknesses of 1/16 to 5/8 inch in standard sheet sizes of 36 by 72 and 24 by 36 inches. Heavy sheet stock in standard thicknesses of 3/4 to 2 inches is also available. Data and samples may be obtained.

Glastic Corp., 4321 Glenridge Rd., Cleveland 21, Ohio.

Designers think of R/M first for asbestos, rubber,

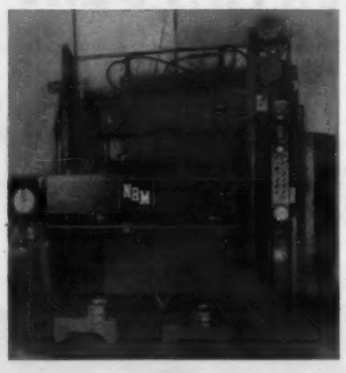
Solves major operating problems for tire press manufacturer with new Teflon*-impregnated molded asbestos piston cups

New molded asbestos piston cups impregnated with Teflon, developed by Raybestos-Manhattan, Inc., have enabled National Rubber Machinery Company, Akron, Ohio, to improve the economy and efficiency of its Autoform Slideback Tire Press while realizing substantial savings. The new seal has not only reduced air loss to a minimum, but eliminated a lubrication system, cut maintenance, and increased machine operating life.

Before adopting R/M cups, NRM used metal rings for the ram and cylinder assembly. These did not provide the seal required, permitted a 5 to 10% air loss, caused excessive wear on moving parts, and required lubricants which were entrained, seeped into the molds, and damaged the tire rubber.

In considering a suitable replacement for the metal rings, NRM tested various synthetic rubber and leather cups. All deteriorated rapidly in temperatures up to 380°F. Then R/M was consulted. Preliminary investigation indicated asbestos with a Teflon filler as a potentially good combination for this application. Nearly a year of research, testing and engineering collaboration followed. Samples were developed and tested in the field under actual operating conditions. Only when all results were in—after two years—did NRM adopt R/M cups for use in all its presses.

R/M's experience in the manufacture of packings, gasket materials, and specialty products to meet the exacting and varied requirements of industry is at your disposal—whatever your need call on R/M.



The application of R/M piston cups provided two important benefits. It eliminated oil in the curing room, preventing damage to the tire rubber. It reduced air loss with properly fitted and installed cups.

Registered trademark for Du Pont fluorocarbon resins

PACKINGS

For complete information on R/M Molded Piston Cups and other R/M packings and gasket materials, write for new Catalog P-100. Packing Division, Raybestos-Manhattan, Inc., Passaic, N.J.

Circle 55 for more information on Packings

sintered metal, and engineered plastic products

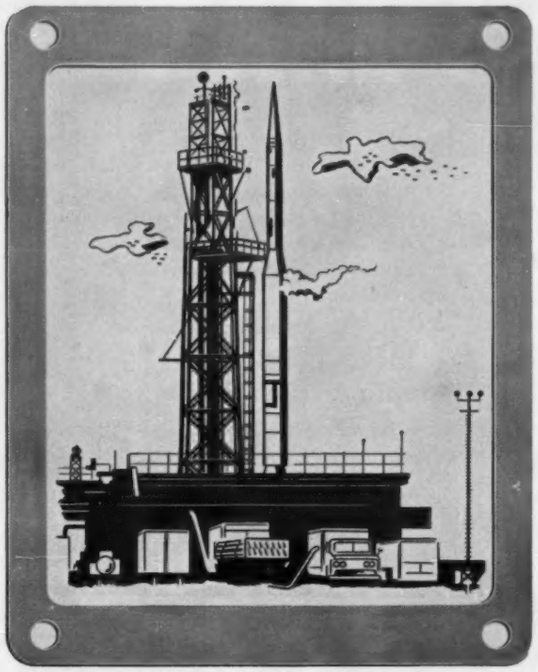
Non-burst Rubber Steam Hose
Strength of steel, heat resistance of asbestos, flexibility of rubber

For saturated steam pressures to 200 lbs., 388°F. Strength and durability are employed throughout the construction of Super-Master BW Steam Hose, illustrated above. Braids of high-tensile, non-corrosive steel wire are applied at a controlled angle over an asbestos-covered steam-resistant rubber tube for greatest strength with minimum elongation and contraction, and provide positive protection against bursting. Special Butyl rubber cover resists heat and weather, has static dissipating wire. The safest high-pressure steam hose made. Write for Bulletin M630.

Rubber hose for every purpose—air, oil, suction, Teflon hose for corrosive chemicals, flexible rubber pipe and expansion joints for abrasion and vibration... outlasts steel pipe. Write for Catalog M5.

RUBBER

Write today for free booklet shown: full details on a wide variety of industrial rubber products. Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J.



Most advanced gasket material yet for missile fuel systems

R/M FLUOROBESTOS*—an asbestos felt impregnated with "Teflon," is fast becoming the accepted gasket material for missile fuel systems.

Approved by leading missile manufacturers for its compatibility with LOX and other exotic fuels, this new material combines "Teflon" and Pyrotex,® a carded asbestos felt based on extra-long spinning grade fiber.

In airborne and ground support applications, gaskets of Fluorobestos offer weight savings, high resistance to acids and solvents, and less deformation under load (as little as 0.1% under pressures of 2000 psi at temperatures to 500°F).

Fluorobestos is available in standard sheets of 40 x 40 in., in thicknesses from .015 to .125 in. Write for complete information and test samples.

**Registered trademark for R/M reinforced asbestos Teflon sheet.*

PLASTICS

For a copy of this booklet, full of information on R/M's complete line of "Teflon" Products, write Plastic Products Division, Raybestos-Manhattan, Inc., Manheim, Pa.

RAYBESTOS-MANHATTAN, INC.

FACTORIES: Passaic, N.J. • Bridgeport, Conn. • Manheim, Pa. • Paramount, Calif. • No. Charleston, S.C.
Crawfordsville, Ind. • Neenah, Wis. • Peterborough, Ontario, Canada

Circle 56 for more information on Rubber

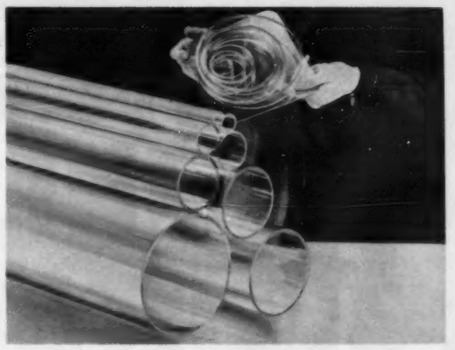
Circle 57 for more information on Plastics

Class F Epoxy Resin 334

A one-part, Class F (155C), epoxy-resin system combines a new degree of flexibility with high-temperature physical and electrical stability. It can be used as a void-free impregnant or encapsulant of components with sensitive core materials or extremely fine wire. The system is noncorrosive, and it has an impregnating viscosity similar to light machine oil (150 cps) at 150C. Shore D hardness of the material is 18, compared to 55 for most typical semiflexible resins. It has a long pot life—seven days at 65C and four days at 95C—and a medium cure cycle, curing in 8 to 16 hr at 150C.

Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.

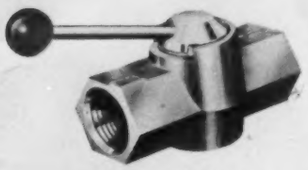
Transparent Tubing 335



Plastic "Butyrate" tubing is now offered in 76 standard sizes ranging from 0.750-inch OD with a 1/16-inch wall thickness up to 6.626-inch OD with a ¼-inch wall thickness. It has a high degree of machinability and can be drilled, sawed, tapped, lathe-turned and cut. It is comparatively inert and can be used safely with many chemicals. Material used in the tubing offers the user an impact strength of 2 lb-ft per inch of notch at 73.4F. This drops to only 0.9 lb-ft at 40F. Tensile strength, flexural strength and compressive strength are all high for the low specific gravity of 1.2.

Busada Mfg. Corp., 32-21 Downing St., Flushing 54, N.Y.

CIRCLE SEAL PLUG VALVE
...LEAKPROOF IN HIGH VACUUM SERVICE



9200 SERIES

Positive sealing in high vacuums to 150 psi. Sizes ⅛", ¼", ⅜", ½", ¾". Available in brass or 303 stainless.

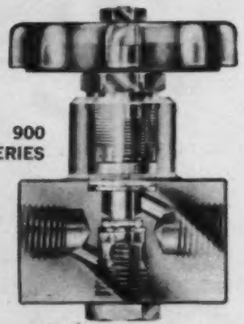
CIRCLE SEAL precision valves

Design of the Circle Seal 9200 Series Plug Valve features use of three O-rings. In closed position, O-ring on cylindrical face of plug prevents leakage past inlet port. In open position, the valve is fully ported and allows straight-thru flow passage. Stem leakage is entirely eliminated by static O-rings at top and bottom around circumference of plug. Effortless quarter turn from full open to full close. No springs used...no adjustments required.

CIRCLE SEAL precision valves

Military Service:
JAMES, POND & CLARK, INC.
Industrial Service:
CIRCLE SEAL PRODUCTS CO., INC.
2181 East Foothill Blvd., Pasadena, Calif.

CIRCLE SEAL
HIGH PRESSURE
SHUTOFF VALVE
...LEAKPROOF
Fingertip Operation



900 SERIES

0-6000 psi. ¼" pipe and ⅜" tube connections. 303 Stainless construction.

CIRCLE SEAL precision valves

Unique design combines **positive** leakproof shutoff with full flow passages and freedom from wire drawing. Design of stem and seat permits simplified throttling of flow. Light fingertip operation actuates either a handwheel or toggle lever for rapid actuation. Unique and useful variations on the basic 900 Series configuration: • Right angle flow. • Integral Relief—combines relief valve function with shutoff permitting cylinder thermal pressure relief, etc. • Triport with one inlet and two outlets or one outlet and two inlets.

CIRCLE SEAL precision valves

Military Service:
JAMES, POND & CLARK, INC.
Industrial Service:
CIRCLE SEAL PRODUCTS CO., INC.
2181 East Foothill Blvd Pasadena, Calif.

Circle 58 on Reader-Service Card for more information

MATERIALS

Solder Flux Remover 336

This safety solvent removes soldering fluxes from electronic circuits. It is lower in cost than fluorinated hydrocarbons and more economical in evaporation rate. "Vythene-PC" has no flash point, is low in toxicity and high in purity. It can be reclaimed with suitable distillation equipment or users can take advantage of the reclamation service offered by the company. Working samples are available.

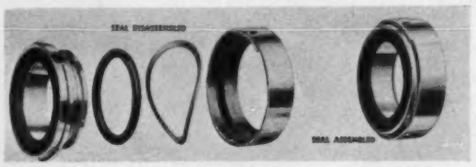
Tect, Inc., Northvale, N. J.

Tapping Fluid 337

Basic ingredient in this tapping fluid is molybdenum disulphide, popularly known as "molly D". The lubricant contains other chemicals including a proprietary adsorption agent known as O.F.33. The product is intended specifically for tapping, threading, drilling, reaming and similar operations. In use, the material provides a highly friction-free layer of lubricant between cutting edge and material being worked, so that metal never touches metal. The compound is stated by the manufacturer to be thermally stable from —90 to 750 F. It does not contain toxic vapors. Under pressures up to 400,000 psi, the coefficient of friction appears to drop as pressure increases.

Arthur C. Withrow Co., 5511 District Blvd., Los Angeles 22, Calif.

Shaft Seals 338



Take-apart shaft seals can be easily disassembled and reassembled by hand. The seals conform to all standard face-type cartridge-seal dimensions, directly replacing all other standard cartridge seals. These design features (according to the manufacturer) result in a number of advantages for the low-volume user of face-type shaft seals. Although low in cost, seals give better sealing efficiency and longer service life by use of a standard O-ring packing and a "Teflon"-coated inner sealing surface. Lightweight aluminum in both adapter and outer shell minimize inertia losses.

Gits Bros. Mfg. Co., 1866 S. Kilbourn Ave., Chicago 23, Ill.

FOR CASTINGS THAT UNDERGO
HEAVY SHOCK AND HIGH STATIC LOADS

SPECIFY
PRECEDENT 71
ALUMINUM CASTING ALLOYS

HIGH YIELD STRENGTH • HIGH SHOCK RESISTANCE

Precedent 71 A and B are high strength, shock resistant aluminum sand casting alloys which in the condition as cast and aged at room temperature, develop the highest combination of physical and mechanical properties of any such alloy now available. Precedent 71A as cast and fully aged has a yield strength of 36,000 p.s.i. As solution heat treated and aged in the T6 condition, it has a yield strength of over 40,000 p.s.i. and still has over 5% elongation. Precedent 71B as cast and fully aged has a yield strength of 32,000 p.s.i. and at the same time has 7% elongation. Precedent 71 A and B offer a combination of high yield strength and high shock resistance not found in other aluminum casting alloys.

Write Today for Free Bulletin

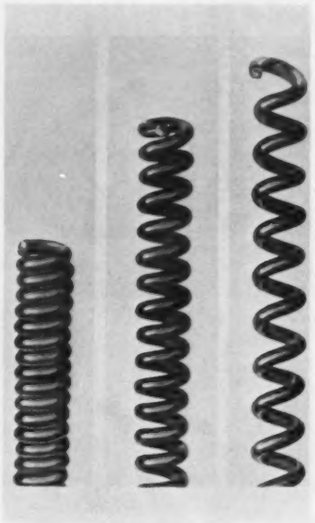
WILLIAM F. JOBBINS INCORPORATED

J

P. O. BOX 230A
AURORA, ILLINOIS

Circle 59 on Reader-Service Card for more information

Retractile Coil Cords 339



Neoprene-jacketed, retractile cords are coiled permanently into a spring shape. They offer an extra degree of safety in many electrical applications, minimize the dangers of entangling and twisting line cords, present a neat appearance, save space and are handy to use. Designed to withstand constant heavy-duty use, cords have prolonged useful life and resist oil and weather damage. They maintain a compact, spring-like shape until used—then extend only to the exact length wanted. Available from stock are power cords, power-cord sets, shielded communication cord, communication coil cords and retractile test-lead wire. Power cords are offered in 48-inch retracted length with maximum extension to approximately 25 ft. Power-cord sets are terminated with a sturdy male plug and have a retracted length of 18 inches with a 7½-ft extended length. Communication cords are 4 ft long, retracted, with an extended length of 25 ft. Retractile test-lead wire has an extended length of 6 ft and retracts to 12 inches. A single conductor of extra-flexible tinned copper with a high-grade insulation is used.

Alpha Wire Corp., 200 Varick St., New York, N. Y.

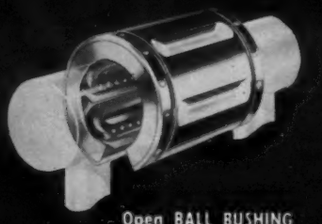
Circle 60 on Reader-Service Card

NOW! *Adjustable Diameter and Open*

THOMSON BALL BUSHINGS

Adjustable Diameter BALL BUSHING for Zero Clearance

Precision Series "A" and Low Cost Series "B" BALL BUSHING



Open BALL BUSHING for Zero Clearance on Supported Shafts

LOW FRICTION · ZERO SHAKE OR PLAY
ELIMINATE BINDING AND CHATTER
SOLVE SLIDING LUBRICATION PROBLEMS
LONG LIFE · LASTING ALIGNMENT

Also manufacturers of NYLINED Bearings . . . Sleeve Bearings of DuPont NYLON

The BALL Bearing for *all* your

LINEAR MOTIONS

Sliding linear motions are nearly always troublesome. Thousands of progressive engineers and designers have solved this problem by application of BALL BUSHINGS on *guide rods, reciprocating shafts, push-pull actions,* or for support of *any mechanism that is moved or shifted in a straight line.*

Improve your product! Up-date your design and performance with Thomson BALL BUSHINGS!

The various types cover a shaft diameter range of ⅛" to 4". Small sizes available in Stainless Steel. Write for literature and name of our representative in your city.

THOMSON INDUSTRIES, Inc.
Dept. J, MANHASSET, NEW YORK

PROGRESSIVE MANUFACTURERS USE BALL BUSHINGS–A MAJOR IMPROVEMENT AT A MINOR COST

GEAR PROBLEMS?

—check with

FAIRFIELD!

GEAR PERFORMANCE to match the ever-increasing power and speed of modern machines is a Fairfield specialty. This is possible because Fairfield has long held a position of leadership in utilizing the most advanced methods, equipment, and techniques for producing better gears EFFICIENTLY, ECONOMICALLY. By keeping apace with modern engineering trends, Fairfield renders an invaluable service to many of the nation's leading machinery builders.

If you have a gear problem, check with Fairfield. Our engineers are well-qualified to give you expert recommendations. *LARGE or SMALL, your requirements will receive prompt attention.* CALL OR WRITE.

SPUR GEARS—Straight, helical, and internal. Sizes from 16 pitch, 1½" dia., to 1½ pitch, 36" dia.

HERRINGBONE—(Follows Type). Sizes from 1½" to 15"

SPIRAL BEVEL—Sizes from 16 pitch, 1½" dia., to 1½ pitch, 28" dia.

STRAIGHT BEVEL—Sizes from 16 pitch, 1½" dia., to 1½ pitch, 28" dia.

HYPOID—Sizes from 1½" to 28" dia.

ZEROL—Sizes from 16 pitch, 1½" dia., to 1½ pitch, 21" dia.

WORMS AND WORM GEARS—Worms to 7" dia. Worm gears to 36" dia.

SPLINED SHAFTS—Lengths to 72".

DIFFERENTIALS—3,000 to 500,000 inch pounds capacity.

Note: All of the sizes above are approximate.

FAIRFIELD
MANUFACTURING CO., INC.
2337 S. Concord Rd. Lafayette, Indiana
TELEPHONE: SHerwood 2-7353

Ask for interesting, illustrated bulletin.

Gears and Differentials *Made to Order for:*

TRACTORS • HEAVY DUTY TRUCKS • AGRICULTURAL MACHINERY • POWER SHOVELS AND CRANES
MINING MACHINES • ROAD GRADERS • BUSES • STREET SWEEPERS • INDUSTRIAL LIFT TRUCKS

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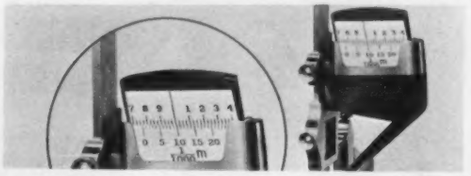
EQUIPMENT

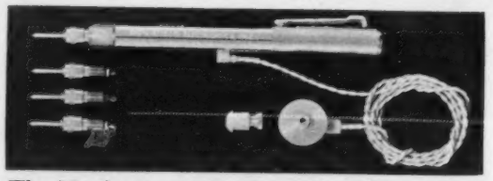
Height Gage Magnifier 340



The "Mark V" is an economical and time-saving magnifying instrument for use on all precision machine tools equipped with a height gage. Readings may be made directly from the magnifying lens without removing gage or turning it horizontally, allowing adjustments to be made in working position. On milling machines, jig borers and radial drills, the device reduces reading time as much as 60 percent and saves operator time by attaching to gage with magnets instead of clamps or screws. The unit incorporates a precision-ground optical lens and mirrors, and magnifies scale numbers 2½ times.

Pan Technics, Inc., 1230 Pan Technics Bldg., Encinitas, Calif.

Transistorized Signal Tracer 341



The "Stethotracer" is a pen-sized, self-contained instrument which can be used as an oscilloscope or a voltmeter preamplifier. Low-level, microwatt, audio and modulated radio-frequency signals can be detected or demodulated. Signals are then amplified approximately 1000 times and reproduced through a high-quality earphone device at output stage. As a preamplifier, the unit enables all general-purpose laboratory oscilloscopes and voltmeters to detect low-level signals in the microwatt region. Output is plugged into scope by means of a specially-designed adaptor plug (available optionally). The equivalent terminated impedance of plug is 600 ohms, fitting most laboratory scopes. Supplied complete with earphone, cord, plug, three attenuator probes, one R-F detector demodulator, interchangeable probes, ground clip lead and battery, the "Stethotracer" is ideal for locating defective circuits and components in the field.

Don Bosco Electronics, Inc., 56 Route 10, Hanover, N. J.

Don't Let
"COUPLING ITIS"

ROB

Your Machines of CONTINUOUS PEAK PERFORMANCE

SPECIFY THOMAS FLEXIBLE COUPLINGS

Like a THIEF in the NIGHT an inferior coupling causes wear and damage to your machines—resulting in high maintenance costs and costly shut-downs.

Troublesome maintenance problems and down time are eliminated when you specify Thomas "All-Metal" Flexible Couplings to protect your equipment and extend the life of your machines.

UNDER LOAD and MISALIGNMENT only THOMAS FLEXIBLE COUPLINGS offer all these advantages:

- Freedom from Backlash
- Torsional Rigidity • Free End Float
- Smooth Continuous Drive with Constant Rotational Velocity
- Visual Inspection while in Operation
- Original Balance for Life
- Unaffected by High or Low Temperatures
- No Lubrication • No Wearing Parts
- No Maintenance

Write for our New Engineering Catalog 60

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

Circle 62 on Reader-Service Card

FOR DESIGNERS AND PRODUCT PLANNERS

*PDCS
*PROTOTYPE DIE CASTING SERVICE

ANSWERS ALL THESE PROBLEMS

If part of the product you are planning is to be a die casting . . . PDCS holds the solution to situations like these . . .

Your customers want samples of your product and you need die castings to complete your samples.

You must test the function of a new assembly which includes a die casting.

You are required to test the strength of a die casting as applied to your needs.

You want to judge the "feel" or appearance of a die casting before final specification.

You must hold down the cost of new product development by avoiding expensive design errors.

You are interested in market testing the sales appeal of a new product and die castings are required to build the needed samples.

PDCS is a newly developed process for creating production-like die castings, in small quantities, at low cost, without permanent tooling charges. Find out for yourself how PDCS can help you by filling out the coupon below and mailing it today.

NEWTON-NEW HAVEN CO.
710 Third Avenue
West Haven, Conn.
NEWTON NEW HAVEN

CUSTOM PRODUCERS OF DIE CASTINGS

I have a problem to which PDCS may be the answer. Without cost to me or my company . . .

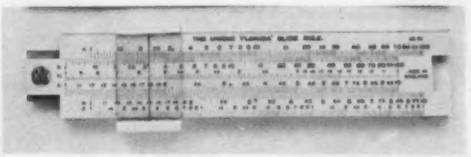
☐ Prints ☐ Models ☐ Sketches are being forwarded under separate cover. Please submit your cost estimate.
☐ Have your representative call.
☐ Send me your free folder, "PDCS . . . Prelude to Production".

A

NAME:
TITLE:
COMPANY:
ADDRESS:

Circle 63 on Reader-Service Card

Engineering Slide Rule 342



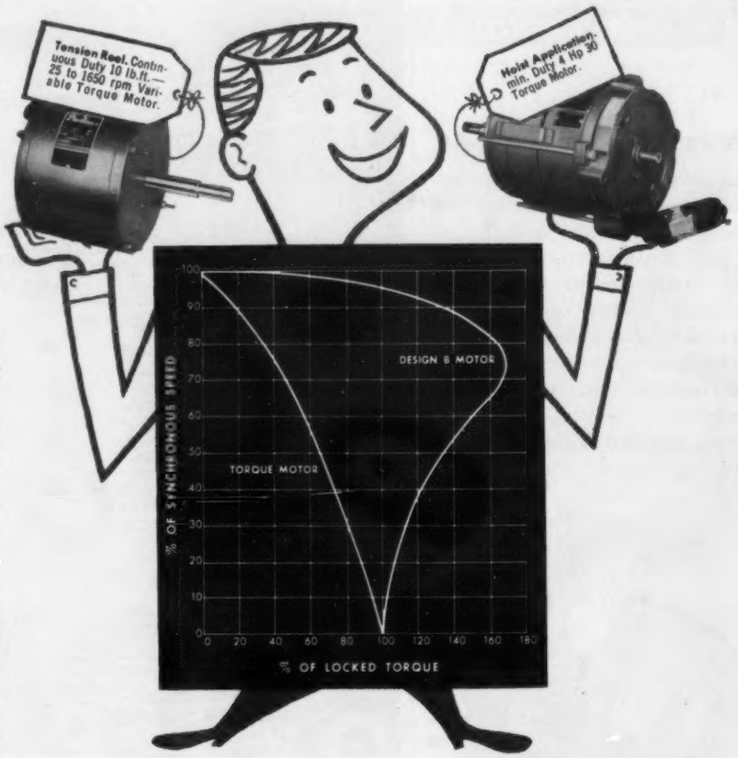
Designed for the engineer, architect, draftsman, instructor and student, the "Jiffy Slide Rule" has standard scale and features high accuracy. The rule is made of hardwood with white plastic facing, engine-divided engraving and fine-quality cursor. The "vest-pocket" instrument (4 inches in length) is packed in transparent-plastic, snap-button carrying case complete with instruction book. The low-cost rule finds many applications in solving mathematical problems.

Nobema Products Corp., 141 Greene St., New York 12, N. Y.

Filtered Grease Package 343

High/low-temperature ball and roller-bearing grease, packed in a ½-oz syringe with needle, will meet or exceed most military specifications. Filtered to 10 or 45 microns, grease reduces the abrasive qualities normally found in most bearing lubrication, resulting in extended bearing life. Primary application of the Model 510 package is in the regreasing of permanently sealed bearings, but filtered grease is useful also in miniature and other precision bearings. Unique packaging eliminates handling contamination. Grease also is available in unfiltered form for other industrial applications where only handling is a problem.

Bearing Inspection, Inc., 3311 E. Gage Ave., Huntington Park, Calif.



Comparative Speed-Torque Curves of NEMA Design B Motor and Typical Torque Motor. The speed torque curve varies from that of a conventional motor. The torque motor curve is almost linear. Maximum torque occurs at the stalled position. For this reason, torque motors are used most often where a holding or resisting force is required.

When holding or resisting force is needed . . . TORQUE MOTORS from PEERLESS ELECTRIC

Motors for tension reel, hoist or those with brake, more often than not call for a special design. That makes Peerless one of your best sources. We custom build torque motors . . . will work with you to produce the *one* motor that powers your product for peak performance.

Or we may already have your torque motor in our line. It includes, among many others, a weather-proof and explosion-proof valve operator torque motor with brakes, 25 lb. ft., 15 min. duty . . . an explosion-proof torque motor with brake . . . a special flange mounting reversing duty hoist torque motor, single phase and 3-phase.

Take your pick, or state your special needs. We have many standard and special frame sizes; all types of mountings; class A, B, F, and H insulation. Ratings from 2 oz. ft. to 200 lb. ft.

Write for our FREE "New Torque Bulletin." Address: *Peerless Electric Division, H. K. Porter Co., Inc., W. Market St., Warren, Ohio.*

PEERLESS ELECTRIC DIVISION PORTER H. K. PORTER COMPANY, INC.

PORTER SERVES INDUSTRY with steel, rubber and friction products, asbestos textiles, high voltage electrical equipment, electrical wire and cable, wiring systems, motors, fans, blowers, specialty alloys, paints, refractories, tools, forgings and pipe fittings, roll formings and stampings, wire rope and strand.

Circle 64 on Reader-Service Card for more information

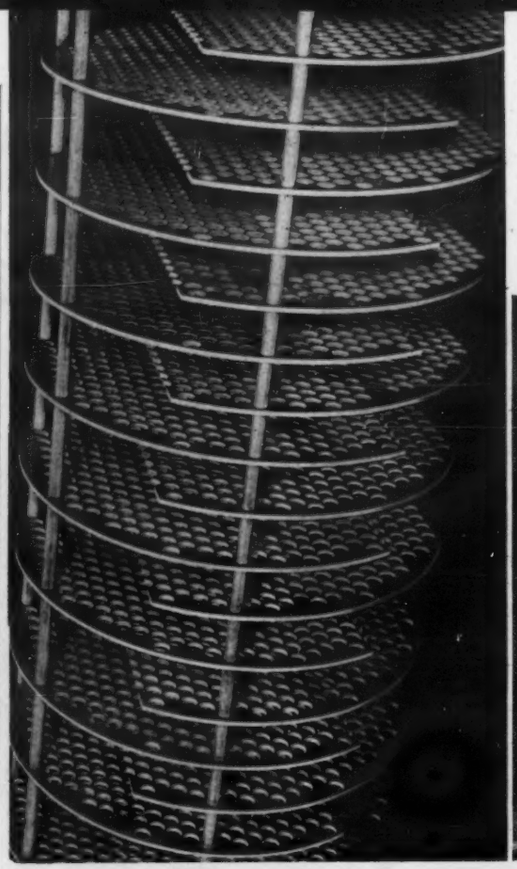
Wire Stripper 344

An all-steel tool that strips insulation from both stranded and solid wire is similar in design to a pair of pliers. A single squeeze on handles strips wire clean, without nicking. Arm automatically drops down to hold jaws open and prevent crushing of stranded wire. After wire is removed, a second squeeze releases arm and stripper is ready for next wire. Alignment of

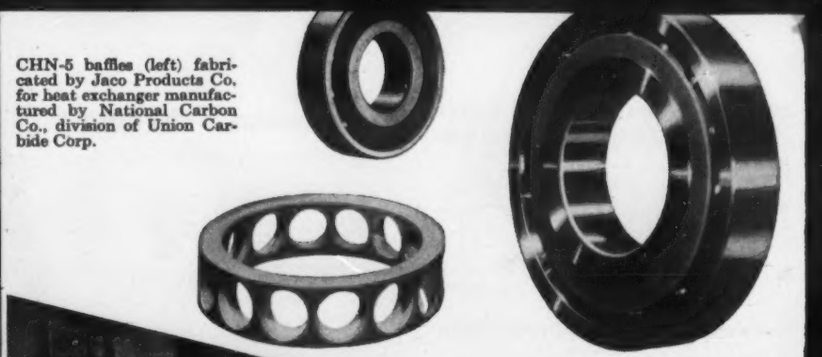
stripping holes to prevent cutting or scoring of wire is provided by "V" notches on stripping blades. Upper blade remains stationary while lower blade moves up and down with piston-like precision in a milled slot. Blades are removable for sharpening and may be replaced if necessary. Overall length of stripper is 7½ inches and weight is 12½ oz. Three models are offered: Model AS-02 for Nos. 22-10 wire; AS-2 for Nos. 18-10 wire, and AS-3 for Nos. 14-8 wire. Tool is useful for stripping building, fixture or telephone wire; lamp and portable equipment cords; radio and instrument wire and cable, and switchboard and aviation wiring.

Holub Industries, Inc., Sycamore, Ill.

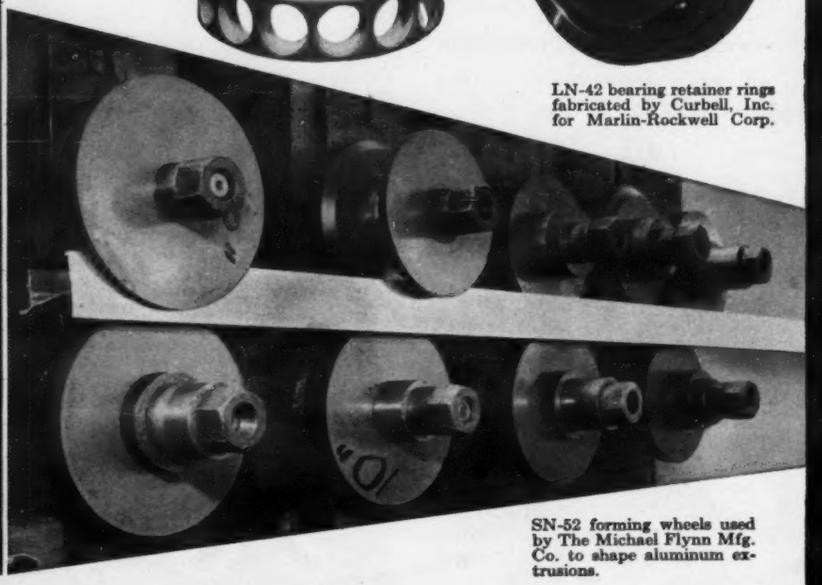
Circle 65 on Reader-Service Card



CHN-5 baffles (left) fabricated by Jaco Products Co. for heat exchanger manufactured by National Carbon Co., division of Union Carbide Corp.



LN-42 bearing retainer rings fabricated by Curbell, Inc. for Marlin-Rockwell Corp.



SN-52 forming wheels used by The Michael Flynn Mfg. Co. to shape aluminum extrusions.

FORMICA® puts the plus in your products...

with mechanical grades offering extra performance per pound

Formica mechanical grades have a remarkable performance-to-weight ratio that can put a new plus in your products. Here's how. First, they're extremely light—weigh only half as much as aluminum. Second, they offer many of the advantages of metals plus many more useful properties such as sound, shock and vibration absorbency, abrasion resistance, insulation, corrosion resistance. In addition, most Formica mechanical grades give you bonus electrical or chemical properties.

Check the chart at right. Then write for data on the Formica grades you need for extra performance and added sales power.

Need fast delivery of Formica parts and materials? Just contact your local Fabricator and Distributor of Formica Industrial Plastics—see list on opposite page.

GRADE	DESCRIPTION
S-52	Paper base-phenolic. Smooth, strong, hard; dent and wear resistant surface; excellent machining. For spinning chucks, jigs, templates, forming dies, structural uses.
C—End Grain	Cotton fabric-phenolic. Strong, abrasion resistant, stable in lube oil; wears evenly, shock absorbent, vibration-free. For machine tool ways. Supports 60 psi at 100 - 500 ft. per minute. Readily machined and installed.
C & CG	Coarse weave cotton fabric-phenolic. Strong, tough, good impact strength, readily machined. CG is heat stabilized for dimensionally accurate gears.
L-42	Fine weave cotton fabric-phenolic. Strong, tough, hard. Excellent machining to extremely smooth finish. For ball-bearing retainer rings, gibs, water-free bearing surfaces and lesser ways.
FF-60	Glass cloth-melamine. High impact, great mechanical strength, flame retardant. For mechanical applications requiring good electrical properties. Meets MIL-P-15037C type GME.
AA-53	Asbestos fabric-phenolic. Strong, high impact, good moisture resistant properties, readily machined. For pump vanes. Also other mechanical applications demanding dimensional stability in similar heat/moisture environments.

FORMICA CORPORATION 4511 Spring Grove Ave., Cincinnati 32, Ohio

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Leed Insulator Corp.
Tri-State Supply Co.
Plastic Stamping, Inc. (Pomona)
San Francisco.....Laminated Fabricators
Tri-State Supply Corp.
San Diego.....Ridout & Co.
COLORADO:
Denver.....Plasticrafts, Inc.
Englewood.....Regal Plastic Supply Co.
CONNECTICUT:
Unionville.....Fabricon Corp.
DISTRICT OF COLUMBIA:
Arlington.....Milton H. Brooks & Son
FLORIDA:
Miami.....Modern Plastics
GEORGIA:
Atlanta.....Southeastern Plastic Sales Co.
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Chicago.....Colonial Kolonite Co.
Tingstol Co.
INDIANA:
Indianapolis.....Hyaline Plastics Corp.
Premier Stamping Corp.
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Jackson.....Plastigage Corp.
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Rochester.....General Circuits, Inc.
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Dayton.....Dayton Plastics, Inc.
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Tulsa.....Ideal Specialty Co.
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Fort Worth.....Plastelite Engineering Co.
Service Engineers, Inc.
Standard Parts & Equipment Corp.
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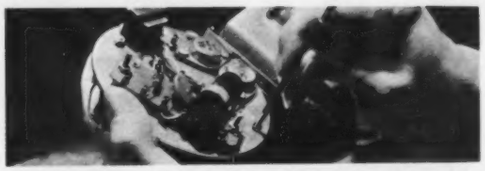
So. Salt Lake City.....Plastic Products of Utah
VIRGINIA:
Bristol.....Williams Co.
Norfolk.....Norva Plastics
Richmond.....Plywood Center
WASHINGTON:
Seattle.....Tri-State Supply Co.
WISCONSIN:
Milwaukee.....General Plastics, Inc.
West Allis.....Colonial Kolonite Co.

Deburring Set 345



Meeting the exacting requirements of the miniature electronics market, this set consists of six 3½-inch long tools, offering a different size of deburring tool at each end. Diameter sizes range from 0.020 to 0.225 inch. All tools have knurled handles and are operated by user spinning handle back and forth between thumb and finger. Each end of tool contains an extra-hard deburring cylinder which turns like a wheel and keeps the cylinder from wearing out in one spot. Set is contained in a small plastic kit and is useful in electronic work where burred surfaces can scratch delicate wires.

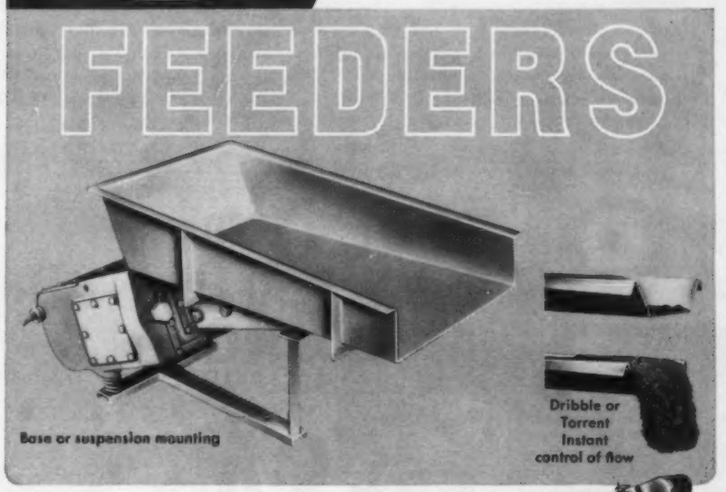
R. N. Hunter Sales Co., Hunter Tool Div., 9851 Alburtis Ave., Santa Fe Springs, Calif.

Transistor Transformer Kit 346

Composed of nine subminiature transformers for servo, audio, instrumentation and control applications, the Model 400-K kit is designed to save the engineer valuable time in optimizing breadboard circuitry. Impedance ratings of transformers cover a range of 150 through 200,000 ohms, matching nearly all of the new transistors. Primary and secondary may be interchanged to give greater selection of impedance ranges. Sizes range from a ⅜-inch cube to ¾ by ¾ by 1 inch. Included in the kit are a nomograph for determining correct output impedances of Class A and B transistor amplifiers; a conversion chart from dbm to milliwatt; a short-form guide to MIL-T-27A; a cross-reference index, and a terminal-connections sheet. Transformers are boxed individually in a transparent plastic case.

Microtran Co., Inc., 145 E. Mineola Ave., Valley Stream, N. Y.

HANDLE BULK MATERIALS AT LOWER COSTS
SYNTRON VIBRATORY FEEDERS



Move bulk materials at constant, dependable, instantly controlled rates

Syntron Vibratory Feeders provide the most efficient and economical method of conveying bulk materials. They have proven for more than 30 years their ability to handle most types of bulk materials — fine powder to large lumps — hot or cold — dry or damp — in densities from 400 pounds to 6 pounds per cubic foot.

The simple electromagnetic drive unit produces 3600 vibrations per minute, assures continuous, dependable operation with a minimum of maintenance. The finger-tip control of material flow enables Syntron Vibratory Feeders to effectively fill the production gap between storage and process operation.

Syntron Vibratory Feeders are available in wide range of feed capacities, with above or below deck magnets, flat pan or tubular troughs, base or suspension mounting.

Syntron Vibratory Feeders are the answer to lower bulk materials handling cost.

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Other Syntron equipment of proven dependable quality.

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Design News • Design News • Design News •

REQUIREMENT: RELIABILITY—A U.S. Explorer Satellite and the revolutionary Bulova "Accutron" wrist timepiece have identical timing mechanisms . . . with accuracy guaranteed to within one minute per month in daily use . . . far more accurate than conventional fine-watch performance, yet impervious to the shock of rocket launching. Deemed best by Bulova is Diall Molding Compound 52-20-30, a Mesa developed and compounded product. The transistorized circuitry is mounted on two bright green Diall moldings, assuring highest insulation characteristics . . . extreme reliability under the most severe environmental and functional stress. Current Diall 52-20-30 applications range from micro-miniature moldings weighing a few grams to large mounting plates weighing as much as 60 pounds. If your requirements include positive reliability, versatile moldability, and/or absolute dimensional stability, write Mesa Plastics Company, 12270 Nebraska Avenue, Los Angeles 25, California

OF ALL TESTED ONLY DIALL® MOLDING COMPOUND ACCEPTED

MESA

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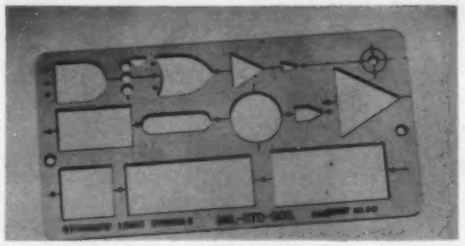
EQUIPMENT

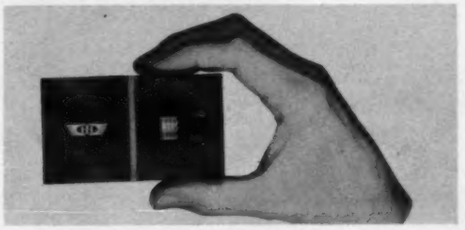
Logic Symbols Template 350



Based on MIL-STD-806A, Standard Logic Symbols Template No. 541 contains cutouts designed for use on engineering logic diagrams associated with digital-processing systems. Template is constructed of 0.060 green-tinted plastic. Overall size is 7-5/8 by 4 inches. All cutouts are beveled for neatness and ease of use.

Rapidesign, Inc., P.O. Box 429, Burbank, Calif.

Pocket-Sized Tester 351



A compact, "secondary standard" test instrument is a direct-reading adjustable voltage source, simulating the d-c electrical output of transducers with a setting accuracy of 0.05 percent. It is used for field or laboratory testing of recording or indicating instruments in the millivolt or microvolt range. The BH153 tester is matched to the curve of any d-c transducer in either direct or indirect terms of reference and simulates outputs of thermocouples, pressure transducers, differential pressure transducers and strain gages in any desired scale units. The scale, which is 12 ft long, can be graduated in several ranges in terms of cardinal points of the instruments to be calibrated—or in a single range with up to 1000 scale divisions. The tester consists of the "Ta'Pot", a potentiometer of infinite resolution, with a bridge network supplied with 115v a-c, 400- or 60-cycle power, Zener referenced. Its size is 4 by 2-3/4 by 2-1/4 inches. The instrument weighs about 8 oz.

Howell Instruments, Inc., 3479 W. Vickery Blvd., Ft. Worth 7, Tex.

IT PAYS TO HAVE HUBBELL GOOD CONNECTIONS

COLD HEADING does it again!

Redesigned for Hubbell Cold Heading, this Brass Switch Handle is

STRONGER MORE EFFICIENT BETTER LOOKING

and only

1/2 THE COST!

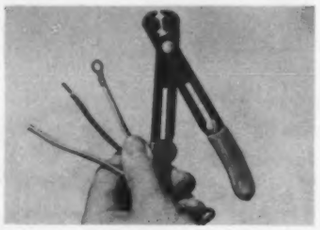
What a difference . . . compared to this old 2-piece screw machine and stamping method . .
Corrosion at joint caused breakage
Both ends drilled and shaved
End piece punched and pierced
Two pcs. joined by hand
Center post staked
Hubbell cold heading now makes the same part in one piece and it's stronger . . . lasts longer . . . costs far less. The customer has only one part to inventory and there's no replacement problem due to breakage.

If your operation uses large quantities of small metal parts formed on automatic screw machines, equal or greater savings may be possible with Hubbell Cold Heading.

HARVEY
HUBBELL,
INCORPORATED
MACHINE SCREW DEPARTMENT
BRIDGEPORT 2, CONNECTICUT

Circle 68 on Reader-Service Card

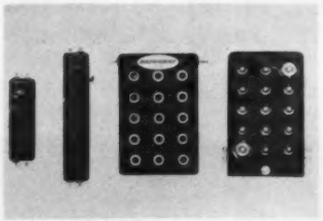
Solder Tool 352



The No. 9900 is a small hand tool that cuts solid or stranded wire, strips off insulation and crimps on solderless terminals. Cutting edge on tool is ground rather than stamped, and versatile unit is made from spring steel. A sliding set screw on one handle can be used when a setting is desired for continuous stripping of a particular size of wire. The compact device will fit into a shirt pocket, yet enough leverage can be obtained to securely crimp a No. 12-10 wire. Low-cost tool is designed to work with wire sizes from No. 22 through No. 10.

R. N. Hunter Sales Co., Hunter Tool Div., 9851 Alburtis Ave., Santa Fe Springs, Calif.

IF Filter 353



A compact communications and navigation filter yields a maximum of 0.5-db bandwidth ripple with a 6:100-db bandwidth ratio less than 1:2. Developed to achieve high selectivity characteristics and temperature stability, the L-C type filter features light weight, compactness for avionic communications, square shape factor, flat top, high reliability and low temperature coefficient. The unit exhibits a maximum frequency drift of 0.1 percent over a temperature range of -40 to 65C. Input and output tanks can be peaked for optimum performance after installation.

Hathaway Instruments, Inc., Hathaway Denver Div., 5800 E. Jewell Ave., Denver 22, Colo.

Circle 69 on Reader-Service Card

P-e-e-l-i-n-g down to a perfect fit

Just a twist of a pen knife when your shims are made of LAMINUM® and you have a perfect fit—right on the assembly line. No machining. No grinding. No counting. No stacking. No miking. No costly stand-by equipment.

LAMINUM is the registered trade name for laminated shim stock that looks and acts like solid metal. Plastic or metallic bonded, the laminations p-e-e-l off easily to give you a perfect fit—right to a thousandth—right on the job.

Custom-made to your own blueprint specifications—in any quantity—shims of LAMINUM are produced *exactly for your job.* In brass . . . mild steel . . . stainless . . . aluminum . . . laminations of .002″ or .003″. You name it! You specify it! You have it!

Find out how LAMINUM can save you time and money on your assemblies. Just write for revised SHIM DESIGN FOLDER No. 4 for complete, up-to-the-minute engineering data.

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* to precisely fabricate O-rings from selected compounds and for specific applications only!

When you buy or specify O-rings, be sure they are right for *your* job. GRC O-rings are precision-molded from a wide range of natural, synthetic and silicone rubber compounds to meet the most critical requirements. What's more, they're available in a complete range of AN, MS, SAE and JIC standard sizes, plus non-standard sizes and special shapes.

Ask for 16-page brochure on sizes, groove dimensions, compounds and other helpful information.

Goshen RUBBER CO., INC.

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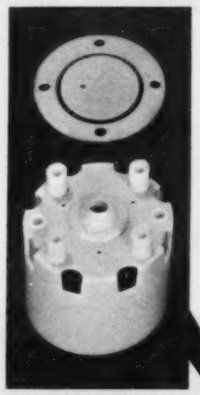
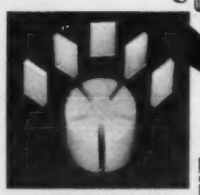
Portable Pump Operates within 'Delrin' Temperature Limit

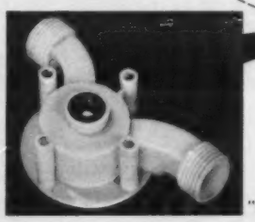
Victor W. Wigotsky, Eastern Editor



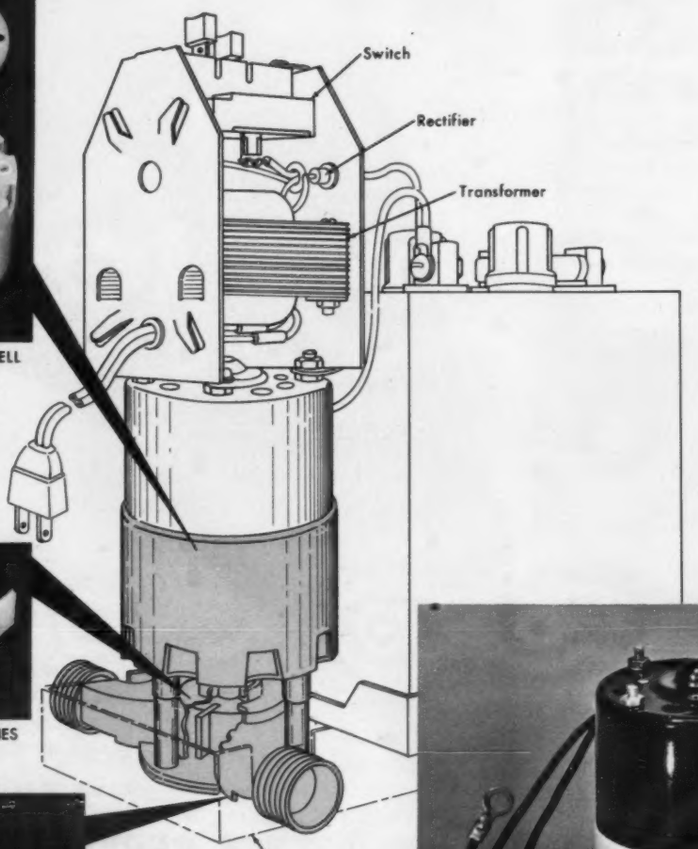
"DELRIN" MOTOR BELL HOUSING AND PUMP COVER



ROTOR AND VANES (NYLON)



"DELRIN" PUMP BODY



MOTOR AND PUMP ASSEMBLY

UNIT CAN PUMP 3 GPM and will run continuously for seven hr on one battery charge. Standard input and output fittings permit use of ordinary garden hoses with ½-inch ID. Pump can raise water 35 ft and is self-priming up to 6 ft lift. Metal parts are noncorrosive stainless steel for salt-water resistance. Unit operates at approximately 1600 rpm under load.

DEPRESSION OF THUMB AGAINST GRILLE permits its removal to reach battery charging cord. Pump weighs under 20 lb, is 12 inches high, 10 inches long and 4 inches wide.

A self-contained automatic portable pump uses "Delrin" to reduce manufacturing cost. The unit operates with an especially built 4v motor, which features lower heat rise for compatibility with the plastic's maximum operating temperature of 180F.

Portability is achieved by use of two 2v wet-cell batteries which can be recharged by plugging into a 110v outlet. However, using conventional material for the pump elements would have raised unit cost. "Delrin" was then chosen as material for the pump housing and motor bell housing to reduce cost over machined bronze and die-cast materials. Machining requirements are almost eliminated, except for relieving the bore of the pump housing and tapping four holes in the motor bell housing.

One problem, when changing to the plastic, was that the operating temperature of the unit was too close to both the high limit of the "Delrin" parts and also that of the high-impact outer case. The high-amperage drain in the operating unit had to be lowered to reduce heat rise before being able to take advantage of the significant weight and cost savings permitted by the "Delrin".

The Dexter 1001 self-contained portable pump was designed by Special Products Div., Russell Harrington Co., Southbridge, Mass.

Circle 71 on Reader-Service Card

Separate motors are attached to each wheel of this 150-ton LeTourneau Jungle Destroyer with BERYLCO beryllium copper bolts.

On land, under the sea, and in space...

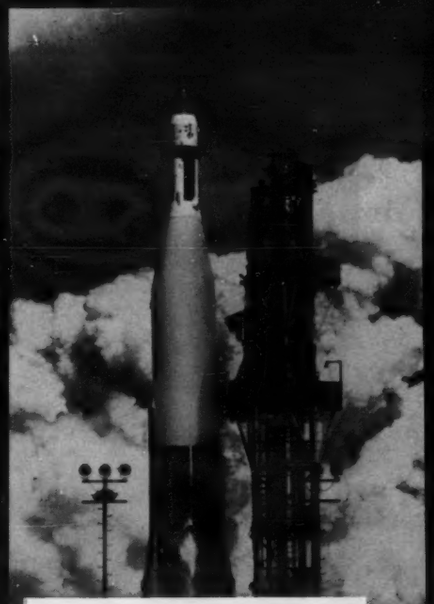
BERYLCO® BREAKS DESIGN BARRIERS

Extraordinary properties and performance characteristics of beryllium metal and its alloys have enabled BERYLCO to assist designers in practically every industry. Creating new products or re-designing existing products, you'll find, as many others have, that checking into the possibilities of BERYLCO metals and alloys is a wise move.

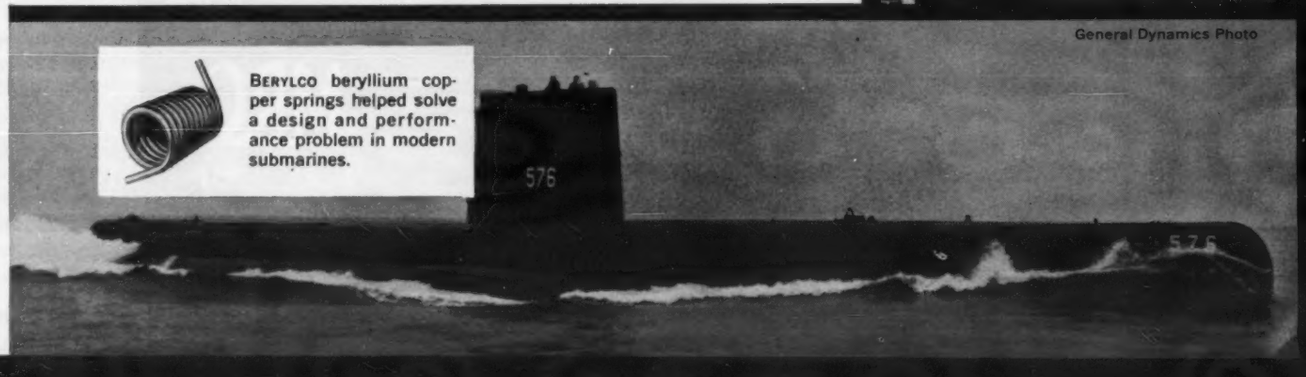
Key parts like bolts for the individually-powered wheels of LeTourneau equipment, components in guidance systems for missiles like the Atlas, and heavy-duty springs in submarines provide higher part performance because of properties found only in beryllium alloys. Good conductivity, formability, high fatigue life, corrosion resistance, and heat resistance are a few of the advantages found in BERYLCO alloys that offer the solution to many material problems.

Write for latest technical information on how BERYLCO beryllium alloys can help you break design barriers. BERYLCO specialists have for over 30 years been helping to turn design possibilities into performance realities.

BERYLCO **THE BERYLLIUM CORPORATION**
READING, PENNSYLVANIA



BERYLCO beryllium copper contacts assure reliability in guidance system circuitry of Atlas missiles.



General Dynamics Photo

BERYLCO beryllium copper springs helped solve a design and performance problem in modern submarines.

MARLIN-ROCKWELL
MRC RELIABILITY COUNTS in the GEORGE WASHINGTON
one of our latest nuclear fighting fish

MRC Engineers, working with the country's leading electric motor manufacturers, have developed the world's quietest, smoothest running and vibration-free bearings for use in the electric motors of our nuclear powered submarines.

While most applications do not require bearings with such extremely close tolerances, the techniques developed to produce these highly successful bearings are employed in manufacturing other bearings to tolerance levels commensurate with the equipment in which they are to be used.

These achievements have contributed greatly to the general overall performance expectations of all types of bearings for any critical applications.

Consult OUR Engineering Department on YOUR Bearing Problems

MRC BALL AND ROLLER bearings

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ship built by GENERAL DYNAMICS

MARLIN-ROCKWELL CORPORATION
Executive Offices: Jamestown, N.Y.

Circle 72 on Reader-Service Card for more information

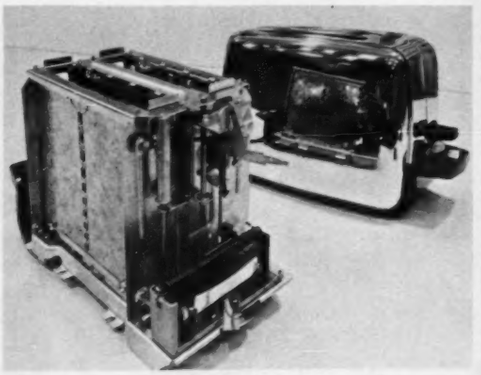
Superalloy Spring

Lars G. Soderholm, Midwest Editor

A 17-7 PH superalloy spring is used to preload a bimetal strip thermostat in a toaster temperature-control unit. The remote thermostat is made with a separate heater that simultaneously heats the thermostat as the main heaters toast the bread. This method of temperature control provides automatic compensation for internal temperature changes in the toaster after successive slices of bread are toasted.

The function of the coil spring is to keep a uniform load on the bimetal strip. After the required toasting time has elapsed, the strip will snap over center, releasing the toaster lift springs and shutting off the current.

Toaster thermostat springs were tested by heating them to 1000F and holding them at this temperature for 24 hours. After this, their tension



and spring rate were checked again. The 17-7 PH springs made of a ferrite austenite alloy passed these tests easily. This alloy consists of 16 to 18 percent chromium, 6.5 to 7.5 percent nickel, 0.9 percent maximum carbon, 0.75 to 1.5 percent aluminum and the balance iron.

Spring tension is adjusted once during production testing. The toaster thermostat has functioned through a test cycle of 20,000 operations —the equivalent of 20 years' use.

The 17-7 PH superalloy spring material is supplied by the National-Standard Co., Niles, Mich., for use by the Sunbeam Corp., Chicago, Ill.

Resists Heat in Toaster Thermostat

Quick, Easy Bonding . . . Laminating . . . Mounting On Any Surface!

Available
in sheets or rolls ½" to 54" wide—custom-sized to your needs! Write for samples, details.

Send $1.00
for big Dispenser Pack ½" Roll! (regular $1.79 value)

KLEEN-STIK — the *modern* bonding agent — replaces and *out-performs* glues, cements, tacks, clips, staples, etc., in hundreds of manufacturing uses! Special moistureless adhesive *sticks tight* on *both sides* . . . attaches anything to anything with money-saving peel-and-press application.

KLEEN-STIK PRODUCTS, INC.
Dept. D · 7300 W. Wilson Ave. • Chicago 31, Ill.

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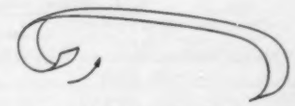
the NEG'ATOR Data Book

HUNTER Springs in Spring

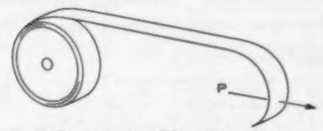
1. FORMS

Forms of the NEG'ATOR Spring

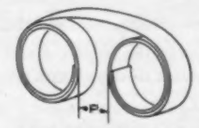
NEG'ATOR® springs start from a flat strip of selected stainless or high carbon spring steel.



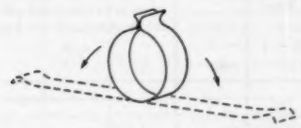
After special prestressing and thermal processing, the NEG'ATOR band exhibits a powerful tendency to curl—uniform throughout its length.



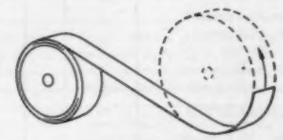
Rolled onto a bushing, it makes a long, *constant-force* spring because it resists unrolling with a uniform pull—the same force at any length.



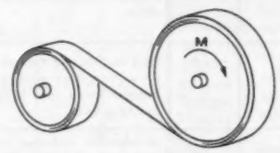
When both ends of the NEG'ATOR band are allowed to form loops, the band becomes a *clamp* of widely adjustable opening and unvarying clamping pressure.



A single or partial coil becomes a strong, resilient *clip* that can be opened completely—even straightened—without permanent deformation.



By reverse-winding the free end around a second, larger drum, we utilize the tendency of the material to recurl to its preset curvature.



The constant output torque available at the shaft of the larger drum provides a powerful, long-running NEG'ATOR *motor*.

How to use it?

■ Movie cameras, electric brush holders, appliance cord retrievers, window sash balances and countless other mechanical and electrical products well known to you now employ NEG'ATOR springs. Write for literature.

The NEG'ATOR spring is a development of Hunter Spring Company.

HUNTER Springs in Spring

HUNTER SPRING COMPANY
A Division of American Machine and Metals, Inc.
10 Spring Avenue, Lansdale, Pennsylvania

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DESIGN DATA NEWS

Design Selector Chart for Copper Alloys

C. L. Bulow, Chief Materials Engineer, Bridgeport Brass Co., Bridgeport, Conn.

The design and manufacture of a fabricated product depends to a large extent on selecting the right metal for the job. Selection of the proper metal, however, requires more than relying on any one single factor or property.

With the wide range of commercial alloys available, the designer can select a material with the proper balance of electrical conductivity, strength, corrosion resistance, machinability, relative cost and available forms which most closely approximates final product design requirements.

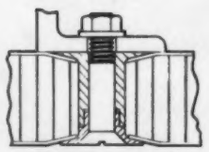
The selection of an alloy for instrument gears, for example, might range all the way from aluminum-silicon bronze which has a machinability rating of 80 and a cost factor of 97 to a high-leaded brass with a machinability rate of 90 and a cost factor of 56.

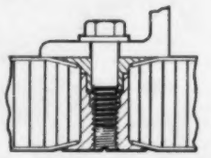
The alloys in the table are divided into nine major groups: Coppers, Brasses, Nonleaded Brasses, Tin Brasses, Phosphor Bronzes, Cupro Nickels, Nickel Silvers, Silicon Bronzes and Aluminum-Silicon Bronzes.

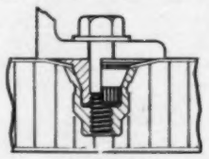
ALLOY AND CHEMICAL COMPOSITION	ELECTRICAL CONDUCTIVITY	*MACHINABILITY	MILL SHAPES	**COST INDEX	PROPERTIES	USES
COPPERS						
SULFUR COPPER Copper 99.7 percent Sulfur 0.3 percent	97 percent	90	Rod Wire	95	Excellent hot working properties with high machinability. May be either silver or tin plated and can be readily soft soldered or silver brazed.	Forgings, cold headed parts and screw machine parts requiring high conductivity, extensive machining and high corrosion resistance. All types electrical connectors, motor and switch parts.
TELLURIUM COPPER Copper 99.5 percent Tellurium 0.5 percent	90 percent	90	Rod Wire	107	High corrosion resistance, excellent hot working properties and high machinability.	Forgings, free machining copper for screw machine and/or drilled parts, conductor assemblies, soldering tips.
ELECTROLYTIC TOUGH PITCH COPPER (ETP)	101 percent	20	Sheet Rod Wire	87	Very ductile; can be drawn, spun, brazed, soldered. Not suitable for oxyacetylene welding because brittleness may occur adjacent to weld zone.	Strip-type transformer winding and tapes, switches, bus bars, circuit breakers, radio, television, electronic parts, terminals, gaskets, heat sinks.
SILVER-BEARING COPPER Silver, 10 oz Troy/ton Avoir, Type STP	101 percent	20	Sheet Rod Wire	91	High annealing and softening temperature.	Does not soften as readily during soldering as OFHC and ETP coppers.
DEOXIDIZED COPPER (DLP) Copper 99.98 percent min	100 percent	20	Sheet Rod Wire Tube	92	Very ductile and malleable. Suitable for oxyacetylene welding. Does not become brittle from hydrogen or reducing gases.	Used for operations involving progressive drawing, flaring, bending with few or no interstage anneals.
DEOXIDIZED COPPER (DHP) Copper 99.91 percent Phosphorus 0.02 percent	85 percent	20	Sheet Rod Wire Tube	92	Suitable for hydrogen brazing, oxyacetylene welding but has lower electrical conductivity than OHFC and ETP coppers.	Hydraulic pressure lines, oil, air and gas lines for conveying liquids in food, paper and chemicals.
OXYGEN-FREE COPPER (Certified OFHC)	102 percent	20	Sheet Rod Wire Tube	100	High purity plus high electrical conductivity. Very malleable; suitable for extra deep draws. Resists embrittlement from hydrogen and reducing gases at high temperatures.	Radio, television, radar, computer, electronic parts, for sealing to glass. Bus conductors, wave guides, tubes, flanges, transistor and rectifier bases, heat sinks, hydrogen brazing.
CADMIUM COPPER Copper 99.1 percent Cadmium 0.9 percent	85 percent min	20	Sheet Rod Wire	115	Better spring properties than copper.	Pole line hardware, wire, contacts, resistance welding tips.
ZIRCONIUM-COPPER OFHC Copper 99.0 percent Zirconium 0.15 percent	92 percent aged	20	Rod Wire	136	Good strength at elevated temperatures and very high softening point.	Resistance welding wheels and electrodes, soldering iron tips, slip rings, rectifier and transistor bases, battery terminals.

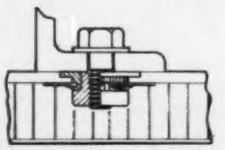
*Machinability based on "Free-Cutting Brass" = 100 **Cost index based on current price of "Oxygen Free Copper", 1/2-inch round rod in 5,000-lb lots = 100

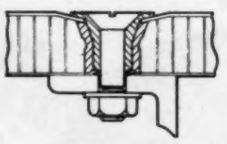
HONEYCOMB and sandwich panel FASTENERS
PATENT PENDING
by Delron

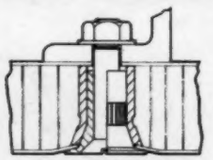

GROMMET FASTENER
Series 101 and 102
Thru-Rivet and Thru-Bolt Type

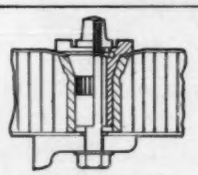

GROMMET FASTENER
Series 103
Series 104 (Self-Locking)

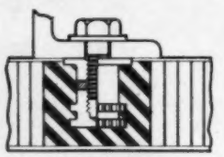

BLIND FASTENER
Series 293
Internal Thread Blind Type


BLIND FASTENER
Series 293K
Threaded Clinch Type

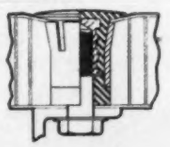

STRUCTURAL FASTENER
Series 600 Flared
Thru-Rivet and Thru-Bolt Type


STRUCTURAL FASTENER
Series 600 Regular
Thru-Rivet and Thru-Bolt Type


STRUCTURAL FASTENER
Series 700
Floating Locknut Type


MOLDED-IN INSERT
Series 404H
Blind Molded-In Type

Illustrated are only a few of the many available types of Delron Sandwich Panel Fasteners. Write for complete Technical Data.


STRUCTURAL PLASTIC FASTENER
Series 680
Internal Thread Type

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Largest Manufacturer of Specialized Sandwich Panel Fasteners

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CASE HISTORY 768

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When specifying dry film lubricants, call for a qualified product under USAF MIL-L-25504 or NAM, MIL-L-22273 (WEP).

Custom shops in principal cities

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STABLE AT—400° F
IDEAL FOR IRREGULAR SHAPES
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NO OUT-GAS IN VACUUM
OPERATIONAL TEMP. TO+500° F
Thermolab element on bearing retainer of lox turbine.
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THERM-O-LAB Sprayed-on Film Type Heating Elements Are SPACE ACCLIMATED!
Completely Inorganic
Applied to: ✓ Stainless ✓ Copper ✓ Glass ✓ Aluminum ✓ Brass ✓ Steel
Specialists in
SPACE HEATING REQUIREMENTS
Since Therm-O-Lab sprayed-on elements are only .015" thick and weigh less than one gram/in², the designer can put heat exactly where needed . . . space acclimated to withstand acceleration, vibration, radiation and cryogenic temperatures. Its total contact to the surface provides maximum heat transfer. Therm-O-Lab offers complete heat system capabilities.
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THERMOLAB CORP.
6940 Farmdale Ave., North Hollywood, Calif.

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ALLOY AND CHEMICAL COMPOSITION	ELECTRICAL CONDUCTIVITY	*MACHINABILITY	MILL SHAPES	**COST INDEX	PROPERTIES	USES
BRASSES, NON-LEADED						
MUNTZ METAL Copper 60 percent Zinc 40 percent	28 percent	40	Sheet Rod Wire	76	High strength combined with low ductility.	Hot forged parts.
CARTRIDGE BRASS Copper 69.5 percent Zinc 30.5 percent	28 percent	30	Sheet Rod Wire Tube	79	Best combination of ductility and strength of any brass. Excellent cold working properties.	Eyelet machine items, electric plug caps, springs, large head cap screws, rivets, strips.
YELLOW BRASS Copper 66 percent Zinc 34 percent	27 percent	30	Sheet Rod Wire Tube	79	Excellent cold working properties combined with good corrosion resistance.	Screw-type lamp bases, sockets, screws, cap screws, rivets, pins, springs, strips, silver-plated contact clips, hardware, solder lugs.
LOW BRASS Copper 80 percent Zinc 20 percent	32 percent	30	Sheet Rod Wire Tube	83	Light golden color. Good resistance to stress corrosion cracking and general corrosion.	Bellows, battery caps, clock dials.
RED BRASS Copper 85 percent Zinc 15 percent	37 percent	30	Sheet Rod Wire Tube	84	Rich golden color. Moderately high strength plus fine ductility. Good resistance to season cracking and corrosion.	Costume jewelry, radiator cores, fire extinguisher bodies, weather-stripping and trim, conduits, eyelets and flexible hose.
COMMERCIAL BRONZE Copper 90 percent Zinc 10 percent	44 percent	20	Sheet Rod Wire Tube	86	Somewhat stronger than copper. Good ductility. Does not work-harden as rapidly as yellow brass; therefore fewer anneals required between operations. Resists season cracking.	Excellent for outdoor service such as lighting fixtures, weather-stripping, door hinges, grill work, screen frames, kick and push plates, building and marine hardware, components for ammunition.
GILDING Copper 95 percent Zinc 5 percent	56 percent	20	Sheet Rod Wire	88	Higher tensile strength than copper. Excellent hot and cold working properties.	Jewelry, coins, fuse caps and primers. Base for articles to be gold plated or highly polished.
LEADED BRASSES						
FREE CUTTING BRASS Copper 61.25 percent Lead 3.4 percent Zinc balance	26 percent	100	Rod Wire	56	Uniform in composition and properties. For high-speed automatic screw machines – fine chips, low tool wear. Good corrosion resistance.	Screw machine parts, clock parts, potentiometer parts, phone jacks and plugs, binding posts, screw terminals.
HIGH-LEADED BRASS Copper 63.25 percent Lead 1.8 percent Zinc balance	26 percent	90	Sheet Rod Wire	56	Suitable for fast machining plus some cold-working such as roll threading, knurling, forming and expanding.	Screw machine parts requiring some cold-working such as roll threading, knurling, forming or expanding, toggle switch parts, binding posts.
HIGH-LEADED BRASS Copper 62.25 percent Lead 2.0 percent Zinc 35.75 percent	26 percent	90	Sheet	56	Superior machinability, generally used in half-hard temper.	Instrument and clock plates, gears, wheels, channel plate.
FORGING BRASS Copper 59.0 percent Lead 1.75 percent Zinc 39.25 percent	27 percent	80	Rod Wire	51	Very plastic in the hot forging ranges, 1200 to 1500F.	Hot forged and machined parts. Marine hardware, valve components, aircraft turn-buckle barrels, balls, bolts, butts, propellers.
LEADED COMMERCIAL BRONZE Copper 89.5 percent Lead 2.0 percent Zinc balance	42 percent	80	Rod	86	Rich bronze color. Moderate strength, good corrosion resistance, machinability.	Nuts, wire and cable connector parts.
MEDIUM-LEADED BRASS Copper 65 percent Lead 1.0 percent Zinc 34 percent	26 percent	70	Sheet	56	Strength and ductility with good machinability.	Gears, nuts, rivets, screws, dials, instrument plates.
LEADED NAVAL BRASS Copper 60.0 percent Lead 1.75 percent Tin 0.65 percent Zinc balance	26 percent	70	Rod	77	Resists corrosion from sea water.	Phone jacks, plugs, marine and naval ware.
LOW-LEADED BRASS Copper 60.0 percent Lead 0.75 percent Zinc balance	27 percent	60	Rod Wire	56	Suitable for cold-working such as flaring and heading, yet has sufficient free-cutting properties for moderate machining and drilling.	Flared, headed, machined, drilled.
MEDIUM-LEADED NAVAL BRASS Copper 60.0 percent Lead 0.6 percent Tin 0.65 percent Zinc balance	26 percent	50	Rod	77	Resists corrosion from sea water.	Marine applications.

* Machinability based on "Free-Cutting Brass" = 100 **Cost index based on current price of "Oxygen Free Copper", 1/2-inch round rod in 5,000-lb lots = 100

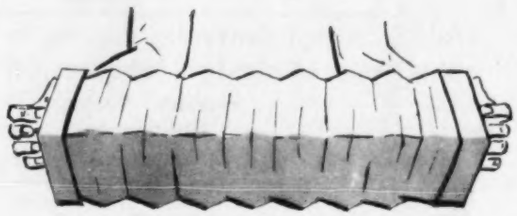
(Continued on next page)

Design Selector Chart for Copper Alloys . . . *Cont.*

ALLOY AND CHEMICAL COMPOSITION	ELECTRICAL CONDUCTIVITY	*MACHINABILITY	MILL SHAPES	**COST INDEX	PROPERTIES	USES
TIN BRASSES						
LEAD NAVAL BRASS Copper 60.0 percent Lead 1.75 percent Tin 0.65 percent Zinc balance	26 percent	70	Rod	77	More readily machinable than Medium-Leaded Naval Brass.	Phone jacks and plugs.
MEDIUM-LEADED NAVAL BRASS Copper 60.0 percent Lead 0.6 percent Tin 0.65 percent Zinc balance	26 percent	50	Rod	77	More readily machinable than Naval Brass.	Bolts, nuts, hardware, meter parts.
NAVAL BRASS Copper 60.0 percent Tin 0.65 percent Lead 0.12 percent Zinc balance	26 percent	30	Sheet Rod Wire Tube	77	Resists corrosion from sea water and salt air. Somewhat stronger, harder and more wear-resistant than Muntz Metal.	Bolts, nuts, hardware, meter parts, hot forgings.
CONTACT BRONZE Copper 92.0 percent Tin 1.9 percent Zinc 6.1 percent	26 percent	30	Sheet		Higher electrical conductivity than other contact bronzes. Also higher conductivity than phosphor bronze alloys.	Substitute for phosphor bronze springs, spring contacts, slide contacts.
CONTACT BRONZE Copper 89.0 percent Tin 1.9 percent Phosphorus 0.15 percent Zinc balance	22 percent	30	Sheet		Excellent spring properties, but not as good as the phosphor bronzes. Very good corrosion resistance.	Substitute for phosphor bronze springs, spring contacts, slide contacts.
PHOSPHOR BRONZES						
FREE-CUTTING PHOSPHOR BRONZE Copper 88 percent Tin 4 percent Zinc 4 percent Lead 4 percent	19 percent	80	Rod	115	High strength and excellent corrosion resistance. Excellent anti-frictional properties.	Free machining bronze. Bearings, bushings, gears, pinions, shafts, thrust washers, slide contacts.
TIN BRONZE (Phono Electric) Copper 98.6 percent Tin 1.4 percent	48 percent	20	Sheet Rod Wire	96	Stronger and more resistant to wear, fatigue and creep than copper.	Pole line hardware, nuts, bolts, screws, clamps, contacts.
PHOSPHOR BRONZE (Grade E) Copper 96.95 percent Tin 1.25 percent Phosphorus 0.05 percent	43 percent	20	Sheet Tube	114	Very ductile. Somewhat stronger and more wear resistant than copper.	Pole line hardware, cable clamps, nuts, electrical hardware, washers, contacts.
PHOSPHOR BRONZE (A) Tin 4.25 percent Phosphorus 0.15 percent	18 percent	20	Sheet	123	Good spring properties where repeated flexing, high strength and stiffness are required.	Springs, snap switches, terminals, fuse clips, meter parts, slide contacts, relay parts, lock washers, diaphragms, bellows.
PHOSPHOR BRONZE 5 PERCENT (Grade A) Copper 94.35 percent Tin 5.5 percent Phosphorus 0.15 percent	18 percent	20	Sheet Wire	123	Highly resistant to corrosion and wear. Low coefficient of friction, high resistance to fatigue. Can be drawn, spun, stamped, formed. Most popular of the phosphor bronze alloys.	Springs, fuse clips, spring contacts, meter parts, slide contacts, relay parts, lock washers, diaphragms, bellows, snap switches, terminals, cotter pins.
PHOSPHOR BRONZE 8 PERCENT (Grade C) Copper 91.9 percent Tin 8.0 percent Phosphorus 0.1 percent	13 percent	20	Sheet	128	Somewhat stronger and harder than phosphor bronze 5 percent.	Same as phosphor bronze 5 percent except for more severe operating conditions.
CUPRO NICKELS						
COPPER-NICKEL-SILICON Copper 97.5 percent Nickel 1.9 percent Silicon 0.6 percent	30 percent	30	Sheet Rod Wire	99	High strength, heat treatable alloy with good electrical conductivity.	Suitable for springs, clips, component holders, bolts, studs, clamps. Compare with beryllium copper.
CUPRO NICKEL 10 % Copper 88.75 percent Nickel 10.0 percent Iron 1.25 percent	9.2 percent	20	Sheet Rod Wire Tube	152	Resists corrosion from clean sea water and other corrosive liquids. Higher creep strength properties at elevated temperatures than brass or copper.	Nuts, bolts, screws, rivets, drawn, spun and formed parts.
CUPRO NICKEL 30 % Copper 68.75 percent Nickel 30.0 percent Iron 0.50 percent Manganese 0.75 percent	4.6 percent	20	Sheet Rod Wire Tube	180	Highest creep strength copper alloy. High modulus of elasticity.	Drawn, spun and shaped parts.

*Machinability based on "Free-Cutting Brass" = 100 **Cost index based on current price of "Oxygen Free Copper", 1/2-inch round rod in 5,000-lb lots = 100

USE AIR PRESSURE—



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For dependable functioning of products or equipment you build, *use pneumatics!* Often, air "works wonders" unmatched by other methods. It's a versatile, controllable, economical medium of force and power through vacuum and pressure.

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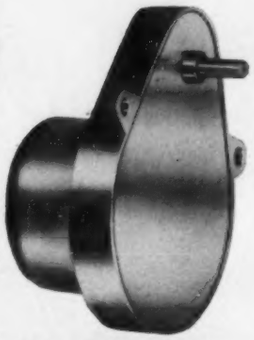
this unique variable pole arm development



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assures 100% STARTING RELIABILITY

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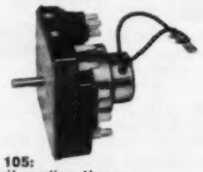
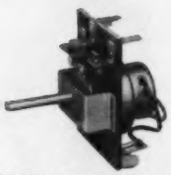
Positive lubrication, heavy duty gear train and high output torque are added reasons why the VP-III motor helps you design better electromechanical devices. Write for bulletin.

Put greater promise in your product . . . specify precision Lake City timers, powered by VP-III motors for absolute reliability —

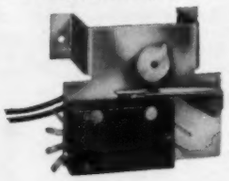
VC-300 variable cam timer, with one to eight circuits.



MODEL 105: 1-6 circuit cycling timer; positive-stopping design.



CD-100: compact, 1-2 circuit timer; dust cover optional.



GT-100: general purpose timer with single DPDT or SPDT switch.

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LC-3-61

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ALLOY AND CHEMICAL COMPOSITION	ELECTRICAL CONDUCTIVITY	*MACHINABILITY	MILL SHAPES	**COST INDEX	PROPERTIES	USES
NICKEL SILVERS						
NICKEL SILVER 10 PERCENT Copper 65 percent Nickel 10 percent Zinc balance	9 percent	20	Sheet Rod Wire	143	Very ductile. Suitable for deep drawing. Yellow-white in color.	Screws, rivets, nuts, bolts, springs.
NICKEL SILVER (A) 12 PERCENT Copper 65 percent Nickel 12 percent Zinc balance	8 percent	20	Sheet Rod Wire	146	Less white than 18 percent nickel silver but possessing similar mechanical properties.	Springs, screws, rivets.
NICKEL SILVER (A) 18 PERCENT Copper 65 percent Nickel 18 percent Zinc balance	6 percent	20	Sheet Rod Wire	157	Excellent base for silver plating. Very ductile, suitable for deep drawings, spinning and stamping. Silver color.	Screws, rivets, springs, nuts, bolts.
NICKEL SILVER (B) 18 PERCENT Copper 55.0 percent Nickel 18.0 percent Zinc 26.85 percent Manganese 0.15 percent	5.5 percent	20	Sheet		Higher tensile and yield strength than Nickel Silver (A), but does not cold work as well.	Spring parts and contacts for telephone boards, radios, controls, springs, resistance wire, diaphragms.
SILICON BRONZES						
LOW SILICON BRONZE (B) Copper 98 percent Silicon 2 percent	9 percent	30	Sheet Rod Wire Tube	98	Very malleable even in hard drawn condition. Resists stress corrosion cracking. Finished cold headed items average over 90,000 psi in tensile strength. Same corrosion resistance as copper. Excellent for outdoor service.	Pole line hardware, nuts, bolts, wire and cable connectors, cap screws, springs, conduits, rivets.
HIGH SILICON BRONZE Copper 96.95 percent Silicon 2.95 percent Iron 0.10 percent	7 percent	30	Sheet Rod Wire Tube	98	Strong, tough and wear resistant. Corrosion resistance of copper. Suitable for spot welding as well as oxyacetylene and arc welding methods. Can be drawn, stamped and spun.	Fire extinguisher shells, small fabricated tanks, outdoor metal and sign work, washers, pole line hardware, equipmen for water works and sewage claiming plants.
HIGH SILICON BRONZE (A) Copper 96.05 percent Silicon 3.0 percent Manganese 0.95 percent	6.5 percent	30	Sheet Rod Wire Tube	98	Can be resistance, oxyacetylene or arc welded, drawn, stamped, machined.	Pole line hardware, nuts, bolts, wire and cable connectors, cap screws, springs, conduits, rivets.
ALUMINUM SILICON BRONZES						
ALUMINUM BRONZE Copper 91.5 percent Silicon 1.75 percent Aluminum 6.75 percent	7 percent	80	Rod	97	High strength, excellent corrosion and wear resistance and good fatigue resistance. Excellent hot forging properties.	Valve bodies, pump parts, cable connectors, pole line hardware, tie rods and water meter parts.
ALUMINUM–SILICON BRONZE Copper 90.85 percent Silicon 2.0 percent Aluminum 7.15 percent	7 percent	80	Rod	97	Very strong. Approximately 90,000psi tensile strength in annealed condition. About 9 percent lighter and 50 percent stronger than annealed Naval Brass rod. Excellent resistance to corrosion and wear. High fatigue resistance.	High strength screw machine or hot forged parts, bolts, nuts, thrust screws, wire and cable connector parts, switchgear.
ALUMINUM BRONZE Copper 95.5 percent Silicon 1.0 percent Aluminum 3.5 percent	12 percent	40*	Sheet Rod Wire Tube	102	Good hot and cold malleability. Good ductility, strength and resistance to liquids and gases.	Bolts, screws, cold headed nuts, pole line hardware parts, springs.
ALUMINUM BRONZE Copper 96.75 percent Aluminum 2.9 percent Silicon 0.35 percent	15 percent	20	Sheet Rod Wire	98	Malleable both hot and cold. Strong with good corrosion resistance to liquids and gases. Low coefficient of friction. Good ductility.	High strength cold working alloy. Nuts, bolts, for pole line hardware.

*Machinability based on "Free-Cutting Brass" = 100

**Cost index based on current price of "Oxygen Free Copper", 1/2-inch round rod in 5,000-lb lots = 100

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Beam Selection

William Griffel, P. E., Ordnance Engineer,
Picatinny Arsenal, Dover, N. J.

The nomogram and tables will aid in selection of American Standard channels, I-beams and beams with circular cross-section for 14 different loading and support conditions. They also may be used for determining maximum bending moment for given beam configuration.

Example 1: Find the diameter and maximum bending moment of a beam which is center loaded with both ends fixed. Total load = 15,000 lb, span = 40 inches and allowable stress = 55,000 psi.

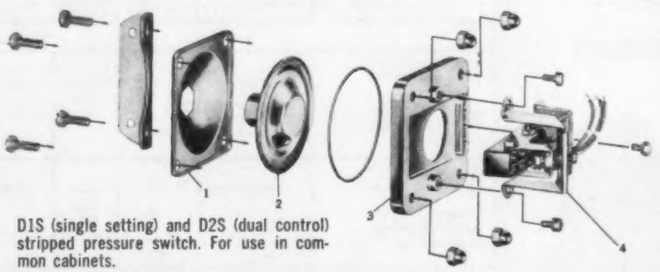
Solution: Referring to Table 1, note coefficient K for given loading condition = 8. On nomogram, align K = 8 with L = 40, intersecting the Reference line. Align this intersection with W = 15,000, intersecting moment scale at M = 75,000 lb-in.

Align M = 75,000 with S = 55,000, intersecting D = 2.4 inches.

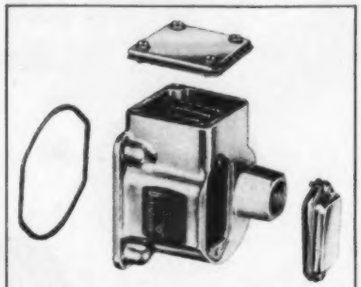
Example 2: Determine the size of U-channel or I-beam that can be substituted for the beam loaded as in Example 1.

Solution: Because loading condition and supports, total load, allowable stress and span are the same as in Example 1, note that D = 2.4 inches corresponds to Z ≅ 1.4 inches³ on the D-Z scale. From Table 2, find a structural member that has a section modulus Z = 1.4 inches³ or greater. Select 3 by 1½ U-channel or 3 by 2⅜ I-beam.

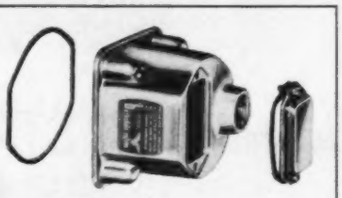
How to put 50% more accuracy into a pressure switch at 25% lower price



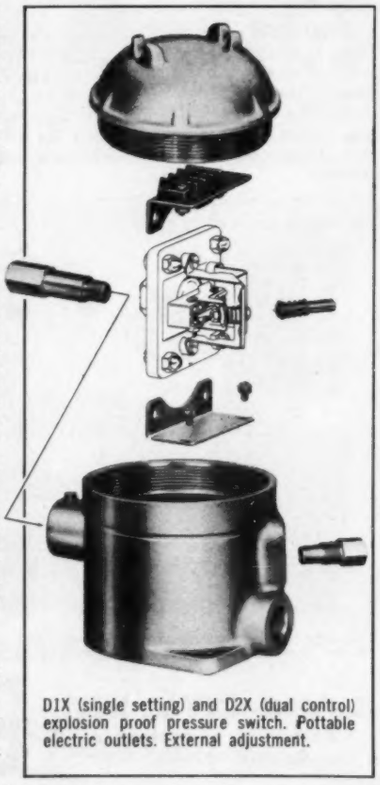
D1S (single setting) and D2S (dual control) stripped pressure switch. For use in common cabinets.



D1T (single setting) pressure switch with integral terminal block. Weatherproof housing.



D1H (single setting) and D2H (dual control) pressure switch with standard housing. Weatherproof.



D1X (single setting) and D2X (dual control) explosion proof pressure switch. Pottable electric outlets. External adjustment.

The accepted standard of accuracy in pressure switches is ±1%. The new Barksdale diaphragm pressure switches are guaranteed for ±0.5% set and re-set accuracy (±0.2% if required). This instrument accuracy, unique proof (test) pressure characteristics, and remarkably easy servicing are accomplished by the use of a "basic unit" diaphragm assembly to which components are attached as required. The erector set principle permits production economies that are reflected in substantially lower prices. The entire concept of Barksdale pressure switches is the result of desired specification improvements as outlined by representatives of varied industries who were consulted before designing was begun.

The versatile basic unit

The basic unit of all Barksdale pressure switches is a leakproof, welded-metal sensing element (No. 2 in the photograph above) surrounded by a heavy protective capsule (Nos. 1 and 3) which is independent of the sensing and switching elements. The hex pressure connection of the diaphragm element fits into a hex opening in the base of the capsule, preventing damage to the diaphragm should the unit be twisted during installation or removal. The standard pressure connection is ¼" npt female pipe fitting; ½" npt fitting is available when specified. The latter was requested by the petroleum industry to facilitate removal of paraffin accumulation and to permit attachment of switches directly to ½" pipe.

Diaphragms easily removable

Diaphragms may be removed without disturbing switch wiring, thus making it possible to change diaphragms to accommodate varying pressure requirements or to substitute diaphragms of different metals as fluid characteristics may demand. This feature cuts inventory costs for original equipment manufacturers because they need stock only diaphragms to meet their various pressure requirements rather than to stock complete switches in every category. It is important, also, to the petroleum industry because only diaphragms (not entire switches) need be carried by personnel doing field service.

Proof (test) pressures to 600 psi

The upper and lower sections of the diaphragm capsule are molded to fit the sensing element exactly. The top section prevents the diaphragm from stretching beyond normal curvature when surges above system pressure are encountered, and there is no possibility of metal distortion that would affect switch accuracy. In the low settings the new Barksdale pressure switches will actuate at 0.1" mercury with proof (test) pressure to 10 psi. In higher ranges they will go up to 600 psi proof (test) pressure at settings to 400 psi. This makes it possible to use inexpensive diaphragm pressure switches on installations that presently require higher priced bourdon tubes.

Stripped switch (single and dual control)

Addition of a switching element (No. 4 above) to the basic diaphragm unit makes a stripped switch for use in a common cabinet with other electrical devices. Original equipment manufacturers need not pay for unneeded housings. Single and dual switching elements are available, and extremely fine adjustment is possible because the adjusting screws have 64 threads to the inch. Adjustment may be made with a screwdriver, or a wrench may be used on the hex head of the adjusting screw to provide extremely fine adjustment.

Standard, terminal block, and explosion proof housings

Addition of a sealed housing (standard, terminal block, or explosion proof) to a stripped switch completes a pressure switch that can be ordered "tailor made" for any desired application. All Barksdale pressure switch housings offer distinctive advantages. In the standard housing, free wire leads are through a ½" nps conduit conductor. Wires are held firmly in place by a special tension clip that prevents disturbing the switch adjustment through careless wire handling. Terminal block housings are available for wiring convenience. Pottable electric outlets are provided on explosion proof housings, and the external adjustment feature incorporated in these housings was suggested by the petroleum industry. Servicing instructions on all Barksdale switch housings are on the inside of a tamper proof cover to allow for painting of units.

Ask for new catalog

New Barksdale diaphragm pressure switches offer you something new in accuracy, proof (test) pressure, and economy. The just-printed catalog tells the complete story. Ask your Barksdale representative or write to Barksdale Valves, 5125 Alcoa Avenue, Los Angeles 58, California.

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Along with outer space . . .
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BIG NEWS
The T-J Spacemaker cylinder line is not new, nor ever has been, a probe into outer space. It is offered as a practically designed, research engineered and time tested product. Its Spacemaker feature (no tie-rods) and rugged construction gives greater strength, saves space and reduces costs in all power drive applications. The Spacemaker is available in a complete range of bore sizes and strokes, air or hydraulic, and contains many plus features and extras as STANDARD . . . NO EXTRA COST! Write Tomkins-Johnson, 2425 W. Michigan Ave., Jackson, Mich. for Bulletin #155-4 and for full particulars, today.
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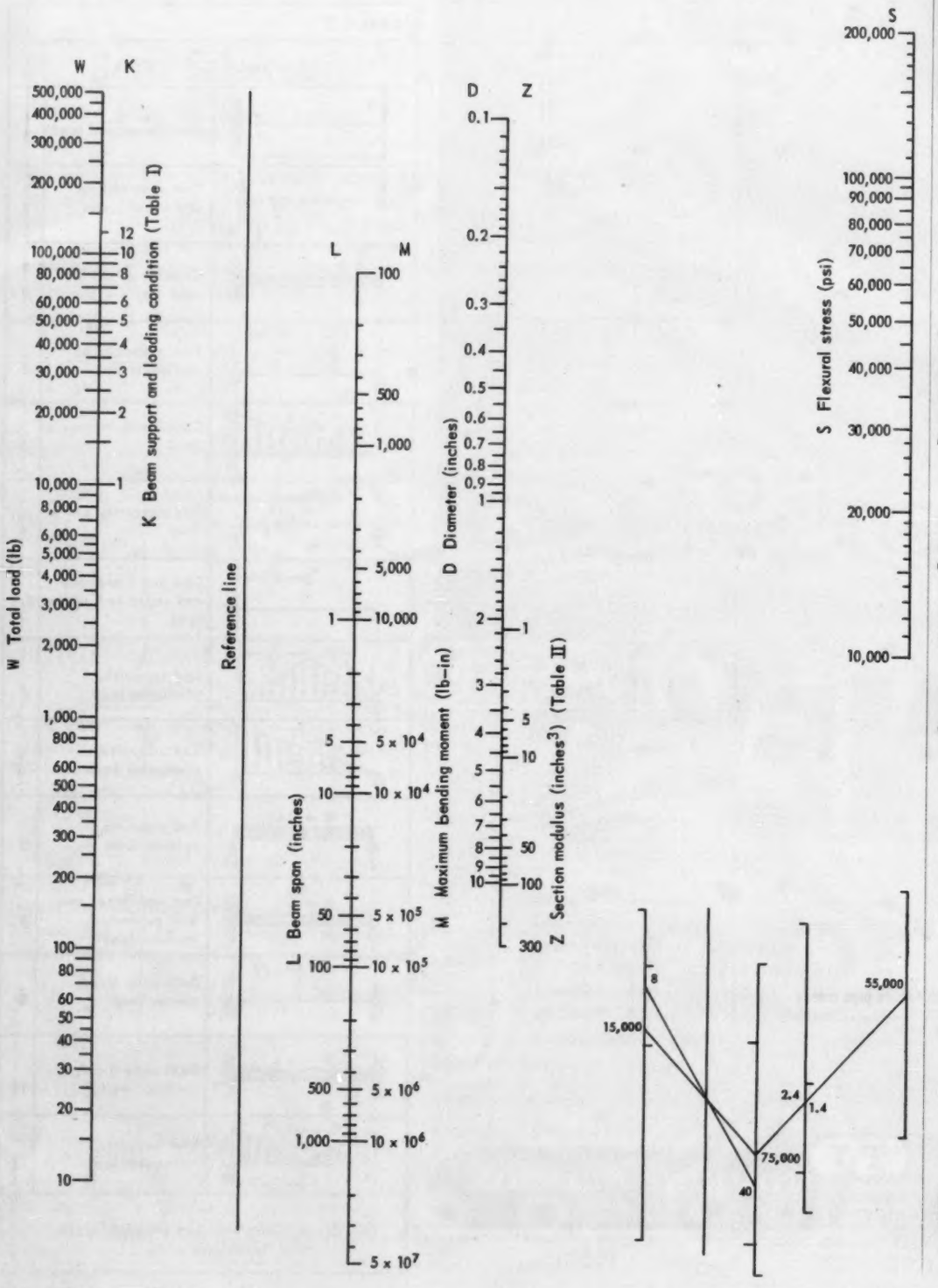
TABLE I

LOADING CONDITIONS		K
W, L	Cantilever, end load	1
w/2, w/2, L, L	Two symmetrical and equal loads	2
W = wL	Cantilever, uniform load (w)	2
W/2, W/2, L, L	Two symmetrical and equal loads	2
W = wL/2, w	Cantilever, triangular load	3
W, L/2	End supports, center load	4
W, L/2	One end fixed, one end supported, center load	5.3
W = wL/2, L/2	End supports, triangular load	6
W = wL/2, w	End supports, triangular load	7.8
W = wL	End supports, uniform load	8
W = wL	One end fixed, one end supported, uniform load	8
W, L/2	Both ends fixed, center load	8
W = wL	Both ends fixed, uniform load	12
W = wL/2, w, w, L/2	End supports, triangular load	12

NOTE: w = Uniform load per unit length
W = Total load = wL

(Continued on next page)

Beam Selection . . . *Cont.*


W Total load (lb)
K Beam support and loading condition (Table I)
Reference line
L Beam span (inches)
M Maximum bending moment (lb–in)
D Diameter (inches)
Z Section modulus (inches³) (Table II)
S Flexural stress (psi)

GRIPCO TOPLOCK NUT
One piece all metal.
GRIPCO CLINCH NUT
With or without self-locking threads. Hex collar prevents turning when torqueing bolt.

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With or without self-locking threads. Centering collar positions nut and protects threads from weld spatter.

You get these "extras" when you specify

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Speed production and lower costs on your products with this GRIP NUT family of GRIPCO FASTENERS. Qualified fastener engineers are available for consultation on all your assembly problems. Consult the yellow pages in your phone book under "GRIPCO" for the one nearest you.

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SOUTH WHITLEY, INDIANA
Phone: South Whitley 723-5111

Subsidiary of Heli-Coil Corporation, Danbury, Conn.

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QUICK CONNECTION
with instant automatic flow

QUICK DISCONNECTION
with instant automatic shut-off
...prevents loss of liquid, gas, or pressure

As easy as plugging in your electric shaver...

Write for the Hansen Catalog

Here is an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings—including Special Service Couplings for LP-Gas, Steam, Oxygen, Acetylene, etc.

To connect a Hansen Two-Way Shut-Off Coupling, you merely pull back the sleeve and push the Plug into the Socket. To disconnect, just pull back the sleeve. No tools required. When Coupling is disconnected, similar valves in Socket and Plug shut off both ends of fluid line circuit—practically eliminating spilling of fluid at instant of disconnection.

Available in brass or steel, with female pipe thread connections from ⅛" to 1½" inclusive. Sizes through 1" are also available in stainless steel.

Representatives in Principal Cities ...see Yellow Pages

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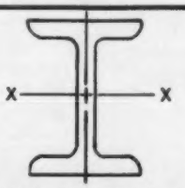
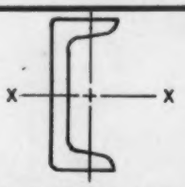
TABLE II



AMERICAN STANDARD I-BEAMS STEEL

Z x–x AXIS (inches^3)	NOMINAL SIZE (Inches)	WEIGHT/FT (lb)
1.7	3 by 2–3/8	5.7
1.9	3 by 2–3/8	7.5
3.0	4 by 2–5/8	7.7
3.3	4 by 2–5/8	9.5
4.8	5 by 3	10.0
6.0	5 by 3	14.75
7.3	6 by 3–3/8	12.5
8.7	6 by 3–3/8	17.25
10.4	7 by 3–5/8	15.3
12.0	7 by 3–5/8	20.0
14.2	8 by 4	18.4
16.0	8 by 4	23.0
24.4	10 by 4–5/8	25.4
29.2	10 by 4–5/8	35.0
36.0	12 by 5	31.8
37.8	12 by 5	35.0
44.8	12 by 5–1/4	40.8
50.3	12 by 5–1/4	50.0
58.9	15 by 5–1/2	42.9
64.2	15 by 5–1/2	50.0
88.4	18 by 6	54.7
101.9	18 by 6	70.0
116.9	20 by 6–1/4	65.4
126.3	20 by 6–1/4	75.0
150.2	20 by 7	85.0
160.0	20 by 7	95.0
173.9	24 by 7	79.9
185.8	24 by 7	90.0
197.6	24 by 7	100.0
234.3	24 by 7–7/8	105.9
250.9	24 by 7–7/8	120.0



AMERICAN STANDARD CHANNELS STEEL

Z x–x AXIS (inches^3)	NOMINAL SIZE (Inches)	WEIGHT/FT (lb)
1.1	3 by 1–1/2	4.1
1.2	3 by 1–1/2	5.0
1.4	3 by 1–1/2	6.0
1.9	4 by 1–5/8	5.4
2.3	4 by 1–5/8	7.25
3.0	5 by 1–3/4	6.7
3.5	5 by 1–3/4	9.0
4.3	6 by 2	8.2
5.0	6 by 2	10.5
5.8	6 by 2	13.0
6.0	7 by 2–1/8	9.8
6.9	7 by 2–1/8	12.25
7.7	7 by 2–1/8	14.75
8.1	8 by 2–1/4	11.5
9.0	8 by 2–1/4	13.75
10.9	8 by 2–1/4	18.75
10.5	9 by 2–1/2	13.4
11.3	9 by 2–1/2	15.0
13.5	9 by 2–1/2	20.0
13.4	10 by 2–5/8	15.3
15.7	10 by 2–5/8	20.0
18.1	10 by 2–5/8	25.0
20.6	10 by 2–5/8	30.0
21.4	12 by 3	20.7
23.9	12 by 3	25.0
26.9	12 by 3	30.0
41.7	15 by 3–3/8	33.9
46.2	15 by 3–3/8	40.0
53.6	15 by 3–3/8	50.0
61.0	18 by 4	42.7
63.7	18 by 4	45.8
69.1	18 by 4	51.9
74.5	18 by 4	58.0

Reference: Steel Construction Manual of The American Institute of Steel Construction, Fifth Edition, 1955.

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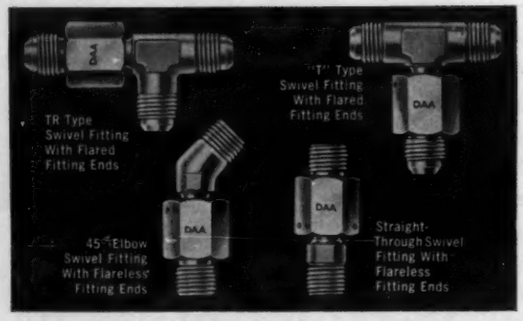
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NEW LITERATURE

Aluminum-Foil Color Chart 452

An aluminum-foil nameplate color chart covers standard colors and finishes in which the nameplates can be manufactured. A total of 14 samples of colors and finishes is mounted on a single card. The colors and finishes are impervious to oxidation, abrasion, corrosion, oil, organic solvents and dilute acids. They will not peel, chip or crack. H. G. Dietz Products Co., 12-16 Astoria Blvd., Long Island City 2, N. Y.

Adjustable Bushings 453

A 32-page pamphlet provides quick description and typical usage of adjustable wall-thickness bushings and associated products. Brochure No. 60A is illustrated with line drawings showing how superior cylindrical fits are obtained in bolting structural joints, clevis and hinge pins, rod end bearing pins, bearing and seal applications. Adjustable Bushing Co., 12036 Vost St., North Hollywood, Calif.

Capacitor Replacement Chart 454

A selection chart and price list of single-section tubular electrolytic capacitors. The 34 tubular types listed on the chart can replace an estimated 100 existing types which may fail in radios, television sets and other electronic equipment. The listings are arranged according to capacity and specify maximum voltage, physical size and manufacturer's list price. The chart can be cut to 7 by 10 inches to display only essential ratings. General Electric Co., Electronic Components Div., Owensboro, Ky.

Phosphor and Photocathode Chart 455

For engineers, physicists and astronomers who work with CRT's, storage tubes, displays or phototubes. On one side of the chart pertinent characteristics of 23 different phosphors are given; on the other side are 14 of the most common cathode materials. Much of the information in this handy reference has not been published elsewhere. A listing of typical products on which the company can provide technical details, prices and applications assistance completes the chart. International Telephone and Telegraph Federal Labs., Fort Wayne, Ind.

Alloy Preform Selector 456

A semiconductor alloy preform selector chart aids in selection of the right alloy for alloying or soldering operations. It lists 56 different alloys arranged in order of solidus and liquidus temperatures. The engineer can refer to the temperature range for which he is looking and find which alloys are available. Based on what type of alloy he requires, he can then make his selection. Each of the alloys listed is workable and available as preforms such as discs, washers or spheres. The list of alloys includes some previously unpublished materials, such as a 707F melting alloy of gold and silicon which can be produced in preforms. Accurate Specialties Co., Inc., 345 Lodi St., Hackensack, N. J.

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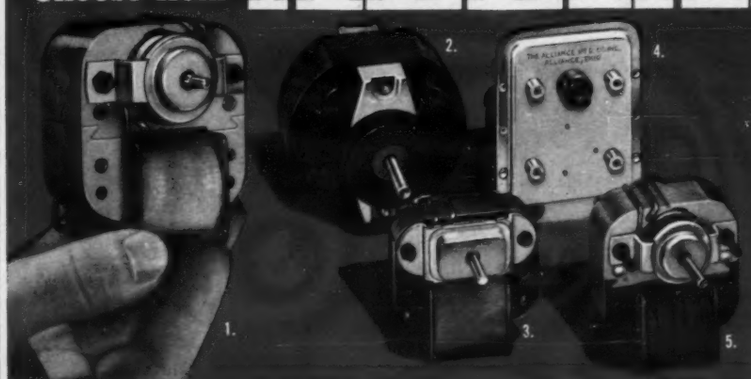

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Fasteners 457

A complete line of fine lock nuts, including clinch nuts, weld nuts, special nuts and semifinished nuts. Size ranges, materials available, physical and mechanical requirements, including welding information for production runs, are detailed. A free slide-rule dimension indicator for fine—or coarse-thread lock nuts is offered in Catalog No. 161, 20 pages. Grip Nut Co., South Whitley, Ind.

Cable Tracer 458

Details of a new instrument designed to speed the tracing of electrial conductors are available from this catalog sheet. It describes two methods by which one man can trace conductors in pipe, conduit and nonmetallic sheathed cable in 1/10 the time normally required. Line drawings show schematically how the two methods are accomplished. Specifications, features and applications of the instrument are included. Pyramid Instrument Corp., Lynbrook, N. Y.

Scientific Research 459

Some contributions made to industrial progress and to the advancement of science through research and education are outlined in this 48-page brochure. Major areas of research interest are chemistry, biosciences, chemical engineering, ceramics, physics, nuclear energy, electronics, metallurgy, mechanical engineering and economics. The report highlights the growth, development and accomplishments of a research institute over the past 30 years, in selected areas of science and technology. Illustrations show physical facilities, and information is given on how a contract research project is initiated and completed. Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio.

Welded Tubing 460

Availability charts list production limits for ultra-thin welded tubing in two forms—cold drawn and bead reduced. Data Memorandum No. 60B is for cold-drawn tubing and gives minimum and maximum wall thickness for tubing diameters from ½ to 4 inches, in both standard and special analyses. Wall thickness can be held as thin as 0.004 inch for all sizes of tubing. Data Memorandum No. 60C is for welded and bead-reduced tubing and gives minimum and maximum wall thickness for tubing diameters from 1½ to 10 inches and lists 86 analyses in which this type tubing is furnished. Available forms listed include rings and cylinders in square, hexagonal, fluted, oval and round. Maximum length is 24 ft. Western Pneumatic Tube Co., Kirkland, Wash.

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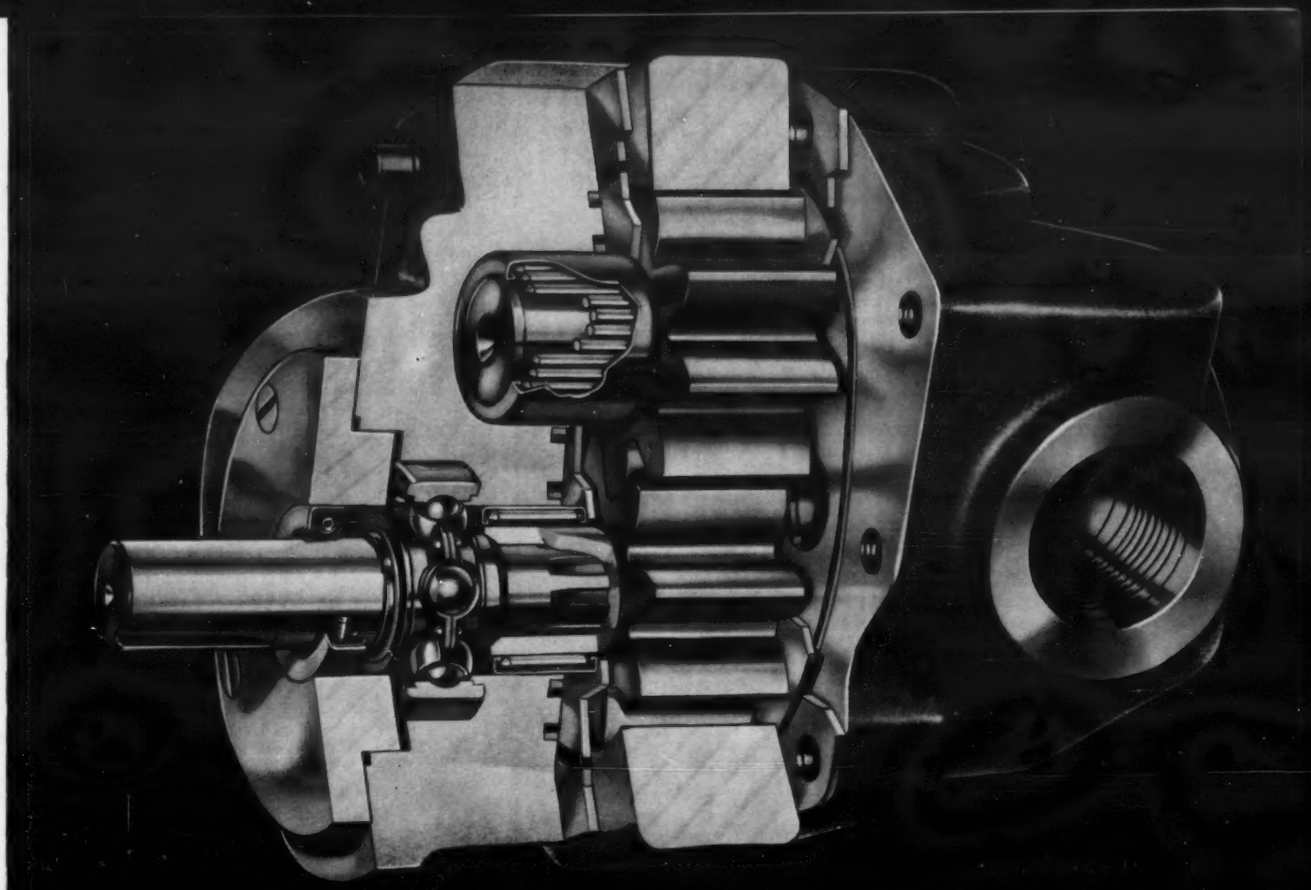

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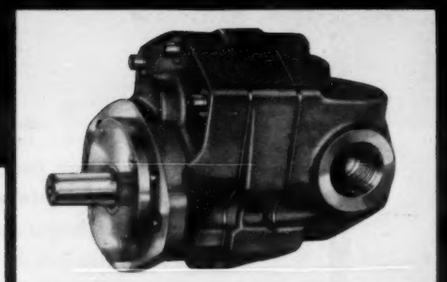

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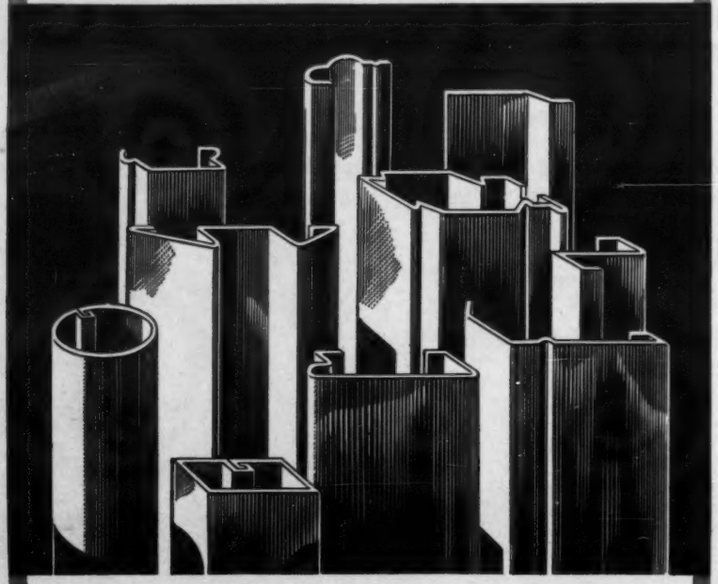

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LITERATURE

Photographic Supplies **461**
Increased emphasis on specialized and scientific photographic equipment makes this 148-page catalog of value to industrial and scientific photographers. Micro and macrophotography cameras for pathology, copying equipment, and complete listings of "Lens Bank" services and lenses, laboratory and darkroom needs, and temperature control systems are covered. This 64th Annual Catalog is a valuable reference source. Burke & James, Inc., 321 S. Wabash, Chicago 4, Ill.

Electroplating Processes **462**
A new edition of an electroplating processes bulletin, EP-103 describes 19 plating and other metalfinishing processes and procedures. Solution preparation, type of deposits, operating conditions, equipment required and applications are listed for each process. Processes covered are "Alcond DX-100", "Copper-Lume", "Levelume 220", "Nickel-Lume", "Permalume", "Superlume", "Nickel Sulfamate", "Silver-Lume", "S-B Zinc", "Zincalume" plus some conversion-coating processes. Hanson-Van Winkle-Munning Co., Matawan, N.J.

Instrument Motors **463**
A new periodical, "Instrument Motor Quarterly", contains articles on performance, selection, application and maintenance of all types of fractional and subfractional horsepower motors. The lead article of the first issue is on lubrication of instrument motors. Another feature will be a regular section entitled "Instrument Motors at Work", which will cover specific applications with emphasis on how the motor contributes to overall performance. Holtzer-Cabot Motor Div., National Pneumatic Co., Inc., 125 Amory St., Boston 19, Mass.

Semiconductor Selection Guide **464**
Includes technical data on 43 devices for military applications and lists the mechanical construction and electrical ratings of every transistor, diode, rectifier and microwave diode in the 500-type semiconductor line. Military units in the 16-page brochure consist of germanium alloy and mesa transistors, microwave diodes, and point contact, gold-bonded, silicon-bonded and silicon-junction diodes which meet the specifications of MIL-E-1, MIL-S-19500, MIL-T-19500 and other USAF, USN and JAN ratings. Detailed information is given on epitaxial silicon and germanium transistors and epitaxial varactor diodes. Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N.Y.

Glass, Glass Compositions **465**
Bulletin 760, 20 pages, describes the manufacturer's engineering and manufacturing service from application analysis and formula development through mold design and custom production. Full-color photographs are included of products used in street and highway traffic control; aviation, railroad and marine signaling; street and interior lighting; dental and surgical lighting equipment, as well as industrial globes, indicator lenses and color filters. Special sections deal with developing glass compositions for individual applications; controlling and combining properties of glass; engineering products with specific characteristics, and testing and inspection. Kopp Glass, Inc., Swissvale, Pa.

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Controls for Flight **466**
Environmental controls, flight and propulsion controls, temperature controls, accessory systems and components make up this 64-page brochure. Products are indexed and all units are illustrated with operating characteristics and physical properties detailed. A sheet of business reply cards is provided for reader convenience. United Control Corp., 4540 Union Bay Pl., Seattle 5, Wash.

Ballast Cross-Reference **467**
Indicates the manufacturer's ballast catalog number equivalents for fluorescent lamp ballasts of other manufacture. The guide contains a ballast rating table and information on mounting dimensions, ETL certification, individual cartons and code dating. Another table lists obsolete ballasts and suggested replacements. Universal Mfg. Corp., 29-51 E. Sixth St., Paterson 4, N.J.

Ceramic Substrate Design **468**
Miniature ceramic substrate made in mass production quantities, often to very close tolerances, using both alumina and beryllia ceramics. Data Sheet No. 7002, three pages, describes microcircuitry, microceramic assemblies and components. Dimensions, tolerances, hole-sizes and advantages of microceramic components are included. Coors Porcelain Co., 600 Ninth St., Golden, Colo.

Electronic Products **469**
A 224-page guide to the newest industrial electronic products lists latest prices and complete specifications on a wide range of electronic parts, equipment and accessories. The catalog is indexed completely by product, by new products and by manufacturer (115 manufacturers are included). As a special feature, the catalog includes a listing of products available at OEM prices. Radio Parts Co., Inc., 6401 Penn Ave., Pittsburgh 6, Pa.

Altitude Tables **470**
Two ready-reference data tables for use by design engineers concerned with altitude pressure and density, and specification of environmental controls for measurement and monitoring. Standard pressures (lb/in^2) and densities (10^{-6} lb/ft^3) are given for each 100 ft of altitude from 0 to 100,000 ft. The tables provide additional information on environmental sensing and switches associated with monitoring and control of pressure and density. Newark Controls Co., 15 Ward St., Bloomfield, N.J.

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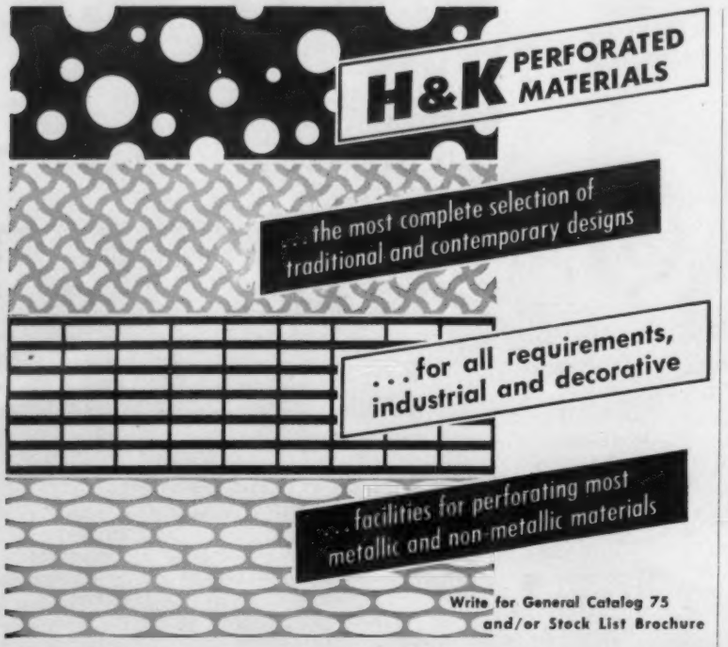
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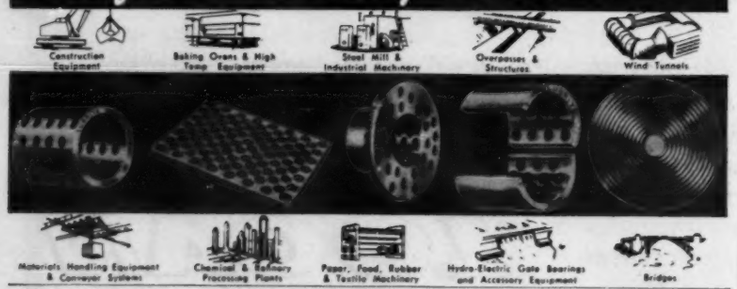
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Thermoelectric Conversion Semiconductors

S. W. Kurnick, R. L. Fitzpatrick and J. F. Leavy,
John Jay Hopkins Laboratory, General Atomic,
Div. of General Dynamics Corp.,
San Diego, Calif.

The rapidly developing field of semiconductors for direct conversion includes those which differ from the known semiconductors (Ge, InSb, PbS and Bi_2Te_3) with controlled impurities. At the high end of the temperature scale (800-1600K), new semiconductors are receiving emphasis in development. $CeS_{1.33-1.50}$ is such a semiconductor and at present the material is sufficiently optimized to give zT's of 0.1 and above.

The study of this semiconductor (n-type) is implemented by the study of a p-type semiconductor, $ThS_{1.71-1.76}$. Progress to date on these materials is discussed. The measurement of thermal conductivity of Ce-S at high temperatures, usually very difficult to make, is made by a small-area-contact technique. In this technique, measurements are performed readily on minute, irregularly shaped specimens as small as 0.2 cm^3.

Introduction

The Ce-S and Th-S semiconductor materials are being studied intensively because of their low lattice thermal conductivities and chemical stability at high temperatures (800-1600K) which make them promising materials for thermoelectric conversion. An important part of the intensive study of these compounds is the determination of the nature of their electric and thermal transport phenomena, parameters which are relatively unknown compared to those of semiconductor materials such as germanium, silicon and lead telluride.

The conduction mechanism in the Ce-S and Th-S semiconductors differs from that associated with the semiconductors Ge, InSb and PbTe, and with the ionic semiconductors such as AgCl in which the Ag^+ ion moves through the lattice. The control mechanism may be best ascribed to that of the polaron model. The basic attributes of this model are consistency with the observed rise in the Seebeck potential with increasing temperature; a slowly decreasing electrical conductivity with increasing temperature, and an extremely small Hall coefficient.

Material Preparation

Ce_2S_3 is prepared from interaction of CeO_2 and H_2S. Result of the interaction is then melted

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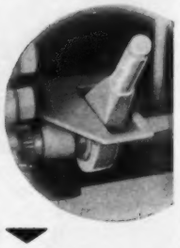

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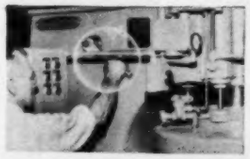

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TABLE 1

RESULTS OF MEASUREMENTS ON Ce-S SAMPLE A - 26

T (°K)	$\gamma \times 10^2$	$\frac{\chi}{\sigma T} \times 10^2$	α (μv/°C)	α' (μv/°C)	σ (mho/cm)	κ (watt/cm-°C)	κ' (watt/cm-°C)
1573	10.0	14.1	448	390	4.7	0.015	0.011
1523	9.2	14.2	425	380	5.12	0.015	0.012
1402	9.35	18.6	359	360	5.5	0.011	0.011
1273	7.85	13.9	442	335	6.0	0.019	0.011
1203	7.95	16.6	395	325	6.1	0.014	0.010
1103	6.38	14.1	404	320	6.37	0.018	0.011
973	7.2	15.2	485	275	6.3	0.020	0.007
300	0.07	5.92	40	40	8.7	0.006	0.006

down to form the compounds $Ce_{2+x}S_{3+x}$ ($0 \leqslant x \leqslant 1$), depending on how much sulfur is pumped off. Material preparation is now being developed along two main lines:

1. The formation of solid solutions of Ce-S with sulfides of barium, strontium and calcium.
2. The synthesis of Ce-S and Th-S free of cracks for reasonably small samples. Some progress is being made in improving the strength of the Ce-S semiconductors by controlling the rate of freezing when the melt is solidifying. A faster rate of freezing provides obsidian-like lustrous material which can be cut by abrasion, which is not fracture-prone and to which leads can be soldered without difficulty. The conductivity of such material runs high, approximately 500 moh cm^{-1}. A contributing factor to the ease of soldering is the high thermal conductivity of the material, which is associated with the high electric conductivity. All other concentrations of the wide impurity range are made by sulfurization or pumping off of the sulfur at moderately high temperatures.

Small-Area-Contact Techniques

Recently developed techniques [1] for the evaluation of the parameters (a dimensionless parameter equal to $(\alpha^2\sigma/\kappa)T$, where T is in deg K) and α have been tested at high temperatures and the results compared with values obtained by more conventional measurement procedures.

Materials which crack readily at low or room temperature can be measured safely since the material is kept above 700C while measurements are being taken. In this way, point contacts are inserted, the charge is melted at about 1900C and the point contacts are formed by inserting molybdenum wires into the melted material. Then the Ce-S semiconductor is frozen, but at no time is the frozen material permitted to descend below 800K. Although this procedure was established as the only sure way to avoid sample loss, some samples show sufficient rupture strength to permit their cooling to room temperature. Because such samples were rare, most were preserved by

(Continued on next page)

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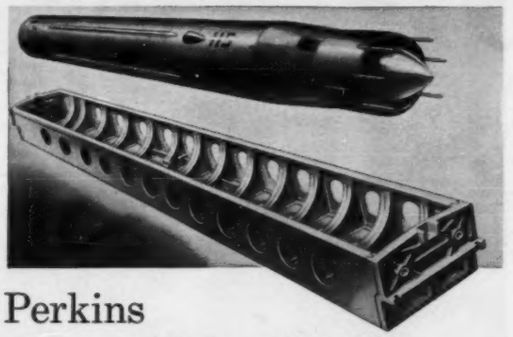

Missile tray made by Brooks & Perkins *beats target weight by 300 lbs.*

Air transported missiles require minimum weight handling equipment so that important defense weapons can be moved efficiently and on schedule. Recently, Brooks & Perkins was given the responsibility for engineering, designing, building the prototype and manufacturing an aluminum missile tray, shown above.

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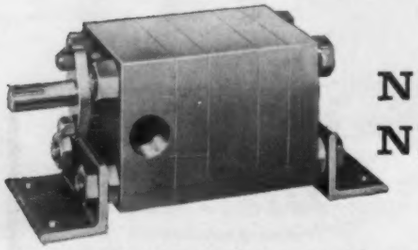

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Semiconductors . . . Cont.

being held at high temperature for some time; one sample was kept at 1100K for four days.

The determination of the figure of merit $\gamma = T\alpha^2\sigma/\kappa$ at high temperature requires values for the thermal conductivity which are usually extrapolated from room temperature data. The most common technique for determining κ is that used in the comparison method described by Francl and Kingery [2]. Briefly, a block of the unknown material is sandwiched between two standard blocks of stainless steel or any other known reference material. When the thermal current has been established as being equal through both standards, the thermal current through the unknown gives the thermal conductivity.

Results

Table 1 lists the data involved in an experimental verification of small-area techniques using a Ce-S sample. In this table parameters measured by conventional techniques are marked with a prime; those measured by the small-area-contact technique are unmarked. The γ and $\gamma/\alpha T$ data are measured from the reversal of the voltage V. Dividing γ by $\gamma/\alpha T$ gives the Seebeck potential α. The thermoelectric power is then measured as a function of temperature by more conventional techniques. The α' values devised by the conventional procedures agree generally within about 10 percent with the α values derived from the small-area contacts. The agreement between α and α' supports strongly the validity of the small-area-contact values of γ and κ.

The conductivity was measured in two ways. First, the potential around the fused-in wire was probed, but the results were invalid because of the occurrence of cracks in the sample. Second, a small filament was sliced from the material used in the crucible and its conductivity was measured as 8.7 mho/cm at room temperature. Since the resistance of the small-area probe could be measured at various temperatures, the conductivity could be determined by normalization.

There are indications in the temperature variations of γ, α and κ of some leveling off at high temperatures. How sharply this occurs is not clear from the data thus far obtained. The values for κ above 973K appear to be sufficiently invariant to be ascribed to the phonon transport. *[1] and [2]. ARS technical paper reference material.*

Abstracted from a technical paper entitled "High-Temperature Semiconductors for Thermoelectric Conversion"; No. 1274-60; American Rocket Society, 500 Fifth Ave., New York 36, N. Y.

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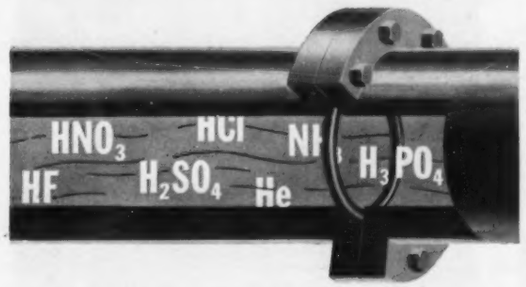

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EFFECT OF TIME AND TEMPERATURE EXPOSURES ON THE CONDUCTIVITY AND MECHANICAL PROPERTIES OF 2024-T4 ALUMINUM ALLOY SHEET USING EDDY-CURRENT METHODS; *D. Hunter, R. Jones and D. Seltzer, The Martin Co., Baltimore, Md. Presented at the Second Annual Symposium on Nondestructive Testing of Aircraft and Missile Components; copies available from R. B. Wangler, Southwest Research Institute.*

A correlation between conductivity and mechanical properties of 2024-T4 aluminum alloy obtained by over-aging the material through exposure to increased times and temperatures. Application is to establish approximate mechanical properties of fire-damaged 2024-T4 aluminum alloy structures in aircraft, based on conversion of conductivity values obtained with the eddy-current FM-100 Magnatest instrument.

THE MOLDED FIBER GLASS TOPLINER; *N. P. Kimberly, Johns-Manville Sales Corp., Detroit, Mich.; SAE No. 321C, $.75; to SAE members, $.50.*

Historical background on headlining installations, development and manufacture of the "Topliner", and the benefits offered both manufacturer and car buyer.

SOME NEW DEVELOPMENTS IN THE HANDLING AND APPLICATION OF HIGH-LEVEL RADIOISOTOPE SOURCES; *J. G. Morse, The Martin Co., Baltimore, Md. Presented at Nuclear Frontiers—The Atomic Industrial Forum—Progress in Radiation and Radioisotope Application, San Francisco, Calif.*

The concept of high-level radioisotopic energy sources has been synonymous with that of high-level radiation sources, such as those used in teletherapy devices and process irradiators. Isotopic sources designed to generate heat and, in turn, electrical power are the subject of this discussion. This application of radioisotope technology was demonstrated to be both feasible and practical for output levels up to several hundred electrical watts in the SNAP-3 device.

FATIGUE DAMAGE UNDER VARYING STRESS AMPLITUDES; *H. W. Liu and H. T. Corten, University of Illinois; NASA TN D-647.*

A physical model of fatigue damage was formulated in terms of the number of damaged nuclei initiated by the highest applied stress and the propagation of damage by all subsequent cycles of stress. Based on this model, a mathematical equation was derived that related the fatigue life to stress history.

EVALUATION AND TESTING OF HIGH-TEMPERATURE OXIDATION-RESISTANT COATINGS ON REFRACTORY METAL SUBSTRATES; *W. L. Aves, Jr., Chance Vought Aircraft, Inc., Dallas, Tex. Presented at the Second Annual Symposium on Nondestructive Testing of Aircraft and Missile Components; copies available from R. B. Wangler, Southwest Research Institute.*

Representative slides supplement various test techniques described for determining the integrity of high-temperature coatings on refractory metals of molybdenum, tantalum, columbium, tungsten and their basic alloys. Nondestructive inspection methods are outlined for determining coating discontinuities by controlled thermal oxidation, infrared emission, fluorescent penetrants and electromagnetic inspection.

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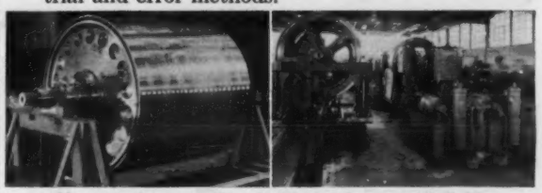

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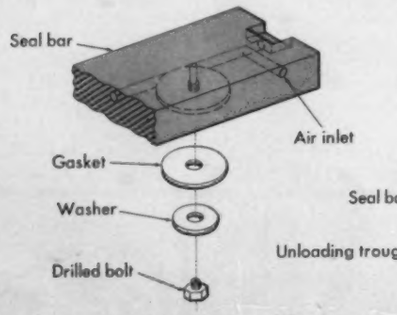
Cycling of Seal Bar and Frame Minimizes 'Claw' Motions

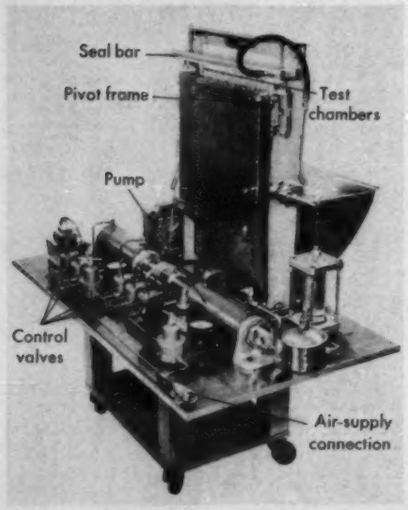
Victor W. Wigotsky, Eastern Editor

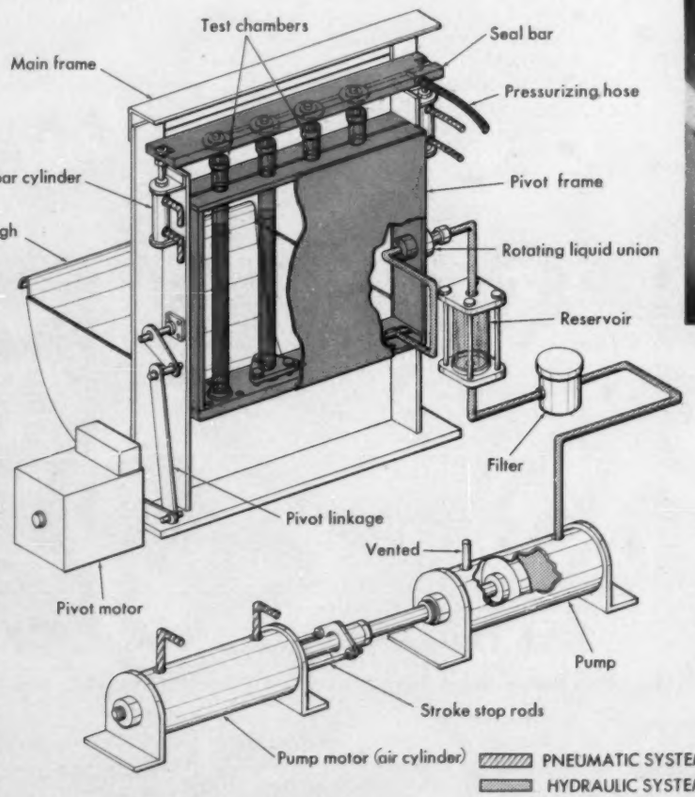
A movable seal bar and a pivoting frame are used in a new capsule leak detector which operates in a "hot cell". Machine leak-tests seal welds on small capsules containing radioactive cobalt-60 strips.

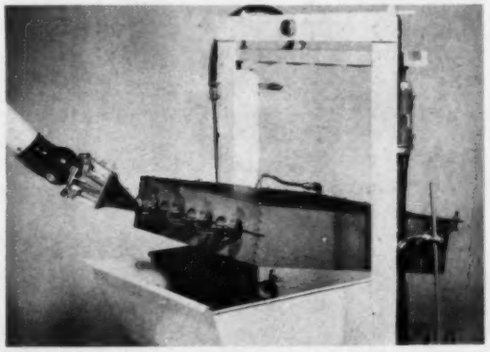
Visual inspection for leaks in the capsules is made from the "hot cell" window. Basic objectives were to minimize and simplify use of mechanical claws and to use standard elements as much as possible.

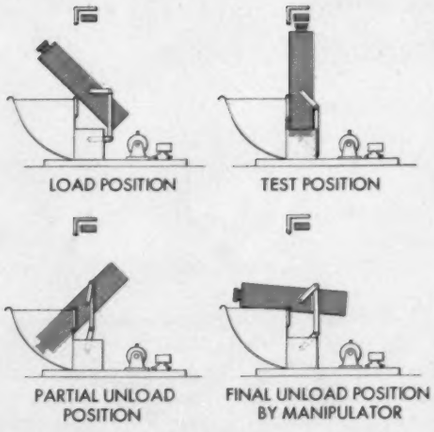
The movable seal bar and pivoting frame are coordinated within a 10-step cycle regulated by a selector switch. Four capsules are first placed in individual sight glasses mounted in the frame. Driven by air cylinders, the seal bar then caps the test chambers and connects them to a compressed air supply. The chambers then are charged with air and submerged



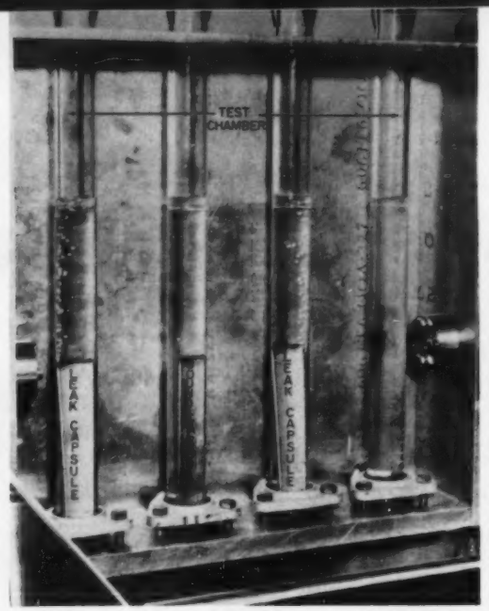








PIVOT FRAME CONTAINS LIQUID DISTRIBUTION MANIFOLD in base which delivers water through rotating union from one-stroke pump to test chambers. Two air cylinders are connected in tandem. Blind end of "pump" cylinder is filled with water and its stroke is limited mechanically by stop rods, eliminating need for liquid level controls. Water contains wetting agent to minimize extraneous bubbles and is returned for continuous re-use. Movable seal bar, with air distribution manifold, permits chambers to be charged with air, sealed and submerged with water. Relief valve maintains constant air pressure in chambers when flooded. Cycle begins as seal bar raises and pivot frame tilts forward to 45-deg angle from vertical. One test capsule is dropped into each of four test chambers. Pivot frame then retracts to vertical position, aligning itself under seal bar which caps and seals test chambers. The chambers are pressurized by 10-psig air through seal bar manifold, and pump forces water into chambers to submerge test capsules. When chambers are vented, violent bubbling of escaping air occurs at all fissures in faulty capsules. Pump then returns all water from chambers while seal bar lifts upward. Pivot frame tilts forward and downward, partially discharging test capsules so that their ends are exposed and resting against inner face of unloading trough. Retraction of frame to horizontal position allows operator to pull out tested capsules by gripping their exposed ends with claws. Pivot frame then swings up to vertical position ready for storage or another test batch.



MACHINE IS POWER-OPERATED AND SELF-REGULATING in all functions so that claw operations are limited to loading and unloading. Unit can test capsules up to 16 inches long and which will slide in a 1-inch bore. Detection apparatus tests several pieces simultaneously to compensate for inherent slowness of operations involving master-slave manipulators. Also, capsules under test are indexed by chamber arrangement to identify leaking capsules.

with water entering through the base. Compressed air forced into leaky test capsules bubbles out violently through the surrounding water when the seal bar lifts off the chambers. This provides a rapid and visual method of detecting faulty capsules from a distance of 10 ft.

The power-operated, pivoting frame reduces claw manipulation to loading and unloading the capsules. A modulating damper drive motor and a standard crank and push-rod linkage drive the frame through four positions. The main control selector switch is simply progressively tapped to four 10w wound resistors.

Emphasis is placed on eliminating machining and using standard parts. For example, a converted air cylinder functions as the pump in the liquid supply system, with a simple mechanical adjustment eliminating complicated valving and liquid level controls. Also, use of a commercial modulating damper motor and linkage to position the frame permits preselected crank arm positions with simple electric circuitry involving no external limit switches and relays.

The machine was designed and built by D. W. Huszagh, W. Ripperger and R. Veverka of Brookhaven National Laboratories, Associated Universities, Inc., Upton, Long Island, N. Y., for use in the High Intensity Radiation Laboratory. Research was carried out under the auspices of the U. S. Atomic Energy Commission.

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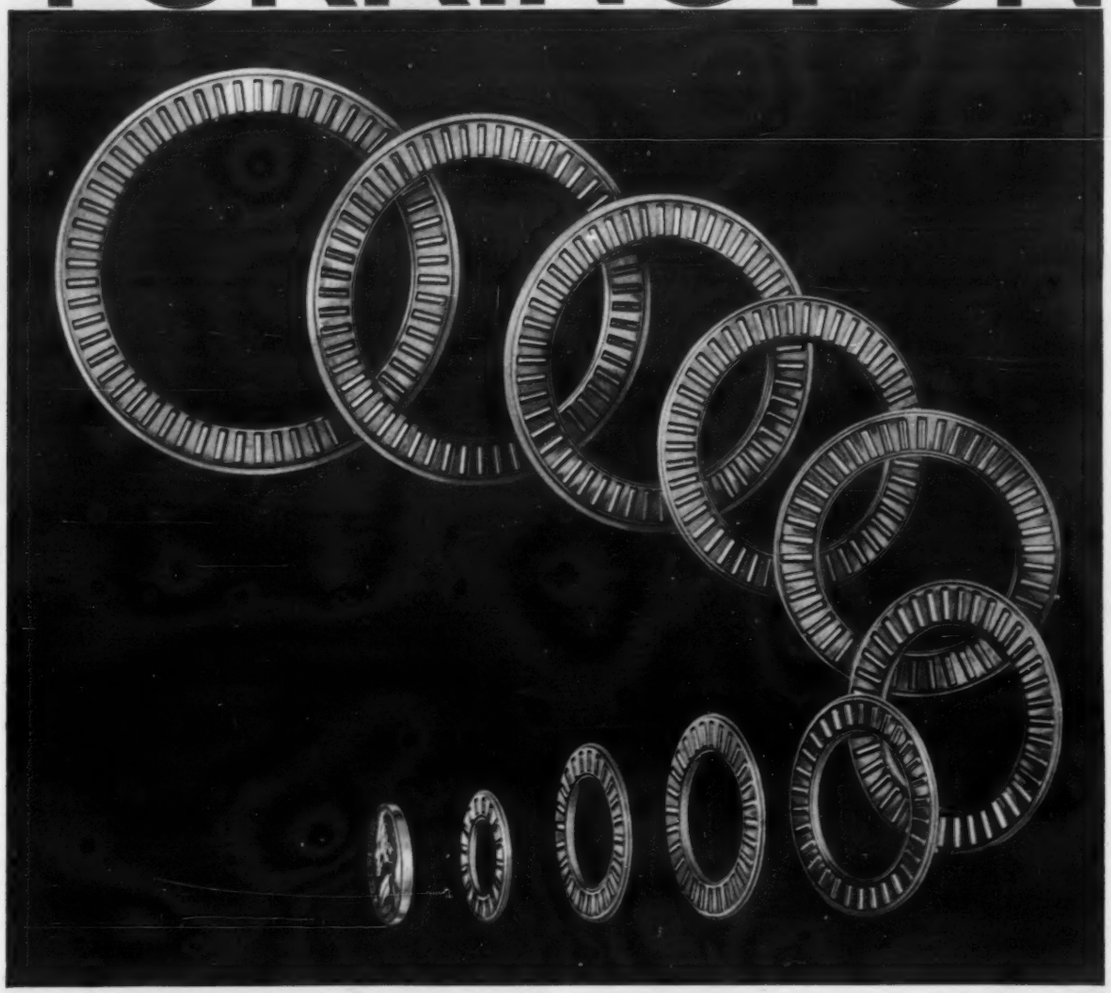

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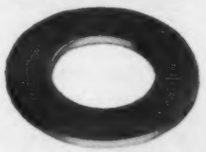

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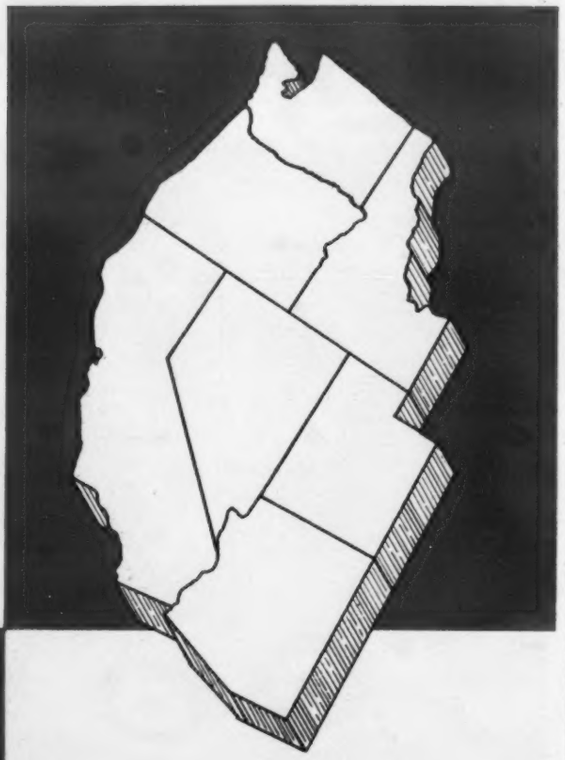

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Engineer-editor Schrader gets the heart of Design Idea with men who made the news.

Self-Pressurizing

Edward W. Schrader, Western Editor

A self-pressurizing reservoir gives a constant return-line pressure irrespective of flow. The hydraulic fluid reservoir is an airless container. In system operation, the device provides inlet pressurization of the hydraulic pump fluid, free from air, with a minimum of foaming and fluid oxidation.

The self-pressurizing reservoir is a key component in a hydraulic starting system for a 250-hp diesel engine that uses a gas turbine auxiliary power unit.

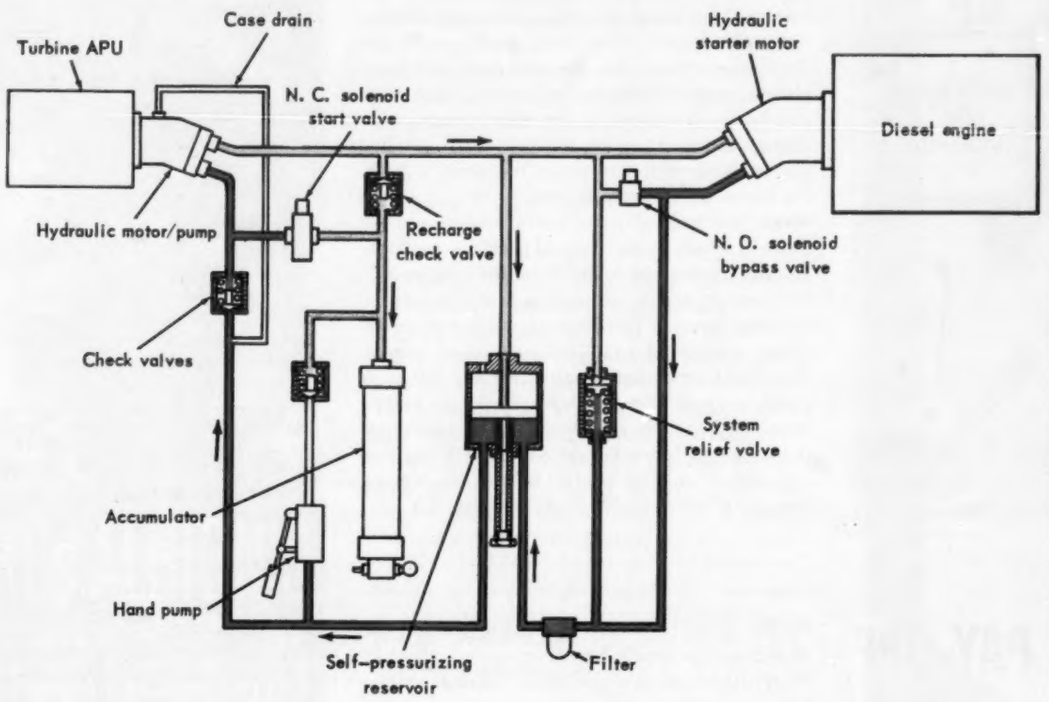
A hydraulic motor/pump mounts on the auxiliary power unit, (APU), and operates first as a hydraulic motor. Flow from an accumulator drives this motor to start the APU. When the APU is started, the motor/pump operates as a hydraulic pump to supply fluid to a hydraulic motor which starts the diesel engine.

The motor/pump, while driven as a pump, also recharges the accumulator for subsequent APU starts. A hand pump in the system recharges the accumulator in the event of loss of charge, such as from an aborted APU start.

An electrically actuated, normally closed solenoid valve opens accumulator discharge flow to

SELF-PRESSURIZING RESERVOIR provides positive-pump supercharged pressure. It is insensitive to attitude of vehicle. Spring-loaded V-rings on piston give dynamic seal, reduce friction and prevent air from entering system during cooling. Nominal pressure ratio is approximately 50:1. Operating pressure is 1000-4000 psi.

Reservoir Gives Constant Pressure to Engine Starter



SELF-PRESSURIZING RESERVOIR maintains constant pressure of fluid to APU-driven pump. System pressure establishes this supply pressure as direct ratio of piston areas. Constant pressure is supplied irrespective of flow demands on hydraulic motor starting diesel engine. Reservoir also compensates for thermal pressure changes.

the motor/pump for starting the APU. The motor/pump operates as a fixed-displacement motor until the turbine starts. A normally open bypass solenoid valve allows flow of the accumulator oil, discharged through the motor, to the self-pressurizing reservoir. After the APU starts, the starting solenoid valve closes and the hydraulic motor/pump operates as a pump. Since this is a load-sensitive system, system pressure does not build up and the turbine runs unloaded until the bypass valve is closed.

Closing the bypass valve forces fluid to flow through the fixed-displacement hydraulic starter motor mounted on the diesel engine. System pressure rises, applying torque to the engine. As the pressure rises, the accumulator is recharged through a check valve. Recharging of the accumulator minimizes pressure surge in the hydraulic system as the starter motor comes up to speed.

With the APU running at 24,000 rpm, the motor/pump is driven at 6000 rpm through a 4:1 gear box. The hydraulic motor starter is driven at slightly less than 1500 rpm. It turns the diesel through its 10:1 gear box at approximately 150 rpm. An overrunning clutch between the hydraulic starter motor and the diesel engine prevents the engine from driving the starter as a pump after starter cutoff.

The self-pressurizing reservoir consists of two integral cylinders with pistons of differential areas moving within them. The ratio of reservoir pressure to system pressure is approximately the inverse ratio of the two piston areas. With a system pressure of 3000 psi, the return pressure is 60 psi. The unused volume of the reservoir is vented to atmosphere.

The self-pressurizing reservoir and hydraulic starting system for the diesel engine are design developments of the Aero Hydraulics Div., Vickers, Inc., Div. of Sperry Rand Corp., Torrance, Calif.

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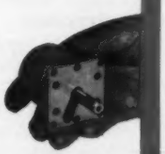

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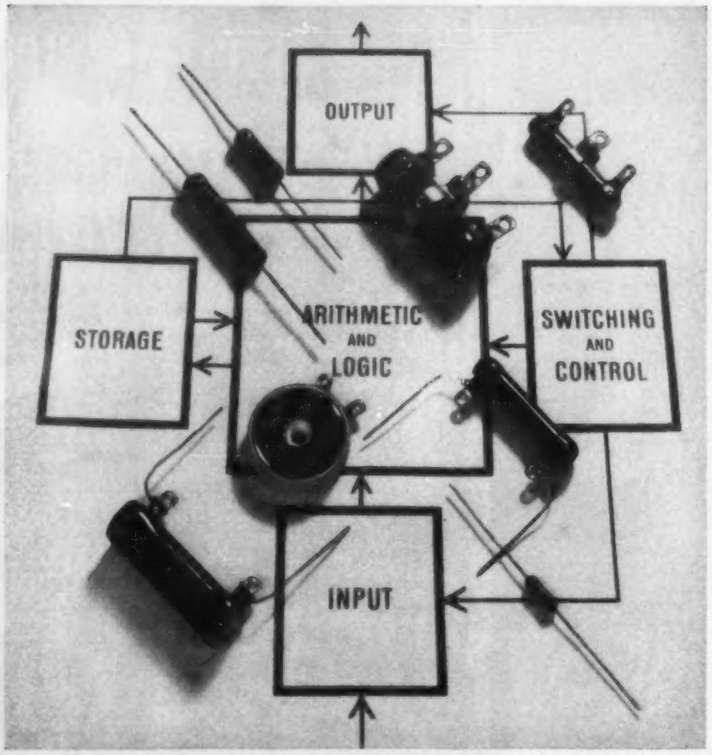

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WARD LEONARD ELECTRIC CO. MOUNT VERNON NEW YORK

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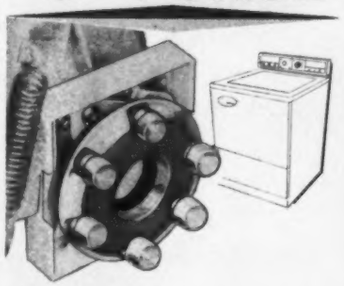
NEW BOOKS

THE DESIGN OF SMALL DIRECT-CURRENT MOTORS presents, in readable style, problems that occur in the calculation and design of d-c machines and some methods used in solving them. Emphasis is placed on the electromagnetic aspects of the design problems and orderly procedure. The thoroughness and completeness that characterize this 407-page book can be seen, not only in the wide variety of design problems it covers, but also in the detailed presentation of the methods themselves. A. F. Puchstein gives methods both for those cases in which mechanical parts are available and for those in which no mechanical parts are available and design must proceed "from the ground up". In every instance, presentation of the method includes precise instructions, alternate procedures, numerical examples and exact results. This $12-publication is suited for use either as a reference or as a text book. Problems calling attention to significant theoretical and practical points are included for the use of both the general and the specific reader. John Wiley & Sons, Inc., 440 Park Ave. S., New York 16, N.Y.

THE CONSULTING ENGINEER performs an important role in the American economy and industry. He renders a useful and valuable service both to governmental and to corporate organizations. Unfortunately, his services and responsibilities are poorly understood. Even some consulting engineers lack adequate comprehension of their responsibilities and obligations. This book presents the major factors relating to the practice of the professional engineer on a consulting level. C. Maxwell Stanley divides this newly published book into two main sections. Part I is concerned with external and professional matters: the function of the consulting engineer and his relationships with clients and others. Part II deals with internal matters: the organization and management of engineering personnel and the procedures and methods the consulting engineer employs. To our knowledge, this is the only book presently available in this field. It should prove interesting and valuable to both consulting engineers in actual practice—and those contemplating this profession—as well as clients who retain and engage consulting engineers to handle engineering work. John Wiley & Sons, Inc., 440 Park Ave. S., New York 16, N.Y.; 258 pages; $5.95.

SYNPRO-TEX Speed Detectors Control "G" FORCE



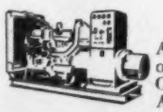
Pats. & Pats. Pend.

In one of the many and varied applications of TORQ speed detecting devices, a single SYNPRO-TEX speed detecting governor is used in a washer-drier appliance to . . . (1) reduce vibration by balancing clothes load. (2) Provide more thoroughly dried clothes. (3) Reduce wrinkling. The SYNPRO-TEX governor automatically cuts out the motor above 1G, switches it back on below 1G for approximately 20 cycles.

SYNPRO-TEX governors are "frictionless", snap-acting, centrifugal switches . . . actuated by speed only, accurate to 0.25% at speeds from 0 to more than 15,000 rpm, for over 1,500,000 cycles of uniform operation. TORQ governors can detect speeds dependably and economically on anything from rotating rat-traps to guided missiles. What's your problem?

MISSILES
Control of rotational speed for ballistic accuracy. Protection and control of components. Ask for Bull. 260.

GAS BURNERS
Fuel control for safety in starting and operation. Blower protection. Ask for Bull. 265.



GAS ENGINE GENERATOR SETS
Automatic switching of cranking cycle. Overspeed protection. Ask for Bull. 264.

These uses illustrate a few of the many ways to increase operating reliability or reduce costs with TORQ speed detecting control.

THE WORLD'S LARGEST MANUFACTURER OF SPEED DETECTORS

TORQ
ENGINEERED PRODUCTS, INC.
30 West Monroe Street Bedford, Ohio
Phone: BEdford 2-4100

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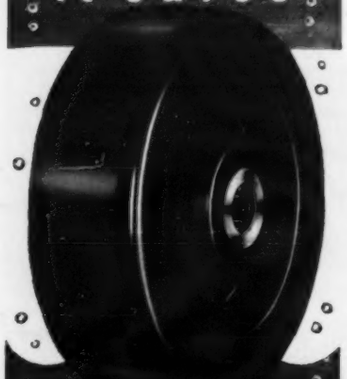
it's new
it wears
it saves



it's ALBION'S
WATER RESISTANT
texite wheel

Specially molded for applications requiring unusual water or chemical resistance . . . plus the usual quiet, long-wearing, easy rolling-floor protective characteristics of Albion Texite Wheels.

These tough, high capacity wheels are immediately available from stock in any practical size from 3¼" to 16" diameters, tread widths from 1½" to 4" and capacities up to 8000 pounds. Plain, roller or sealed bearings. Price? Exactly the same as comparable models in Albion's regular Texite wheel line!

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FREE CATALOG — Albion's big, new 44-page catalog of Industrial Casters and Wheels is ready for your use and convenience. Write for your personal copy — Today!

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PRODUCTION FORECASTING, PLANNING & CONTROL, Third Edition. Including new chapters on sales forecasting, warehouse distribution and control, as well as further information on electronic data processing and military production planning, this third revision of a familiar text is intended to serve the purposes of both the classroom and industrial executives. Summaries at the end of each chapter are an aid for reference use. The final chapter consists of a practical problem in setting up a complete manufacturing plant on paper. The solution to this problem is given in detail. E. H. MacNiece; John Wiley & Sons, Inc., 440 Park Ave. S., New York 16, N.Y.; 402 pages; $9.75.

APPLIED DESCRIPTIVE GEOMETRY PROBLEMS. A set of 77 pages, ready for the drafting board, this series of descriptive geometry problems is designed for teaching the subject, using any one of nine different texts. The plates are all keyed to the various texts by subject and page number. Actual photographs are used frequently to illustrate the problems. For industrial in-plant teaching, this series of problems should be a useful classroom help. The plates are all printed on 8-1/2- by 11-inch heavy drafting paper and should not require the use of extra tracings or separate drawings. Ernest R. Weidhaas; The McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N.Y.; $3.95.

UNITS OF WEIGHT AND MEASURE (United States Customary and Metric)—DEFINITIONS AND TABLES OF EQUIVALENTS. A 1959 agreement among the directors of National Standards Laboratories of English-speaking nations to obtain uniformity in precise measurements involving the yard and the pound have brought about refinements in the definition of the U.S. customary units of length and mass. The agreement created need for this Miscellaneous Publication 233. Units of length, area, volume, capacity and mass in the United States are defined in conformity with the 1959 agreement. The table of interrelation and tables of equivalents for these units in the Metric system and in the U.S. Customary system have been recalculated by automatic computer. Further revisions include the deletion of the table showing interrelation between bushels and hectoliters and the addition of a more complete table showing equivalents of inches in millimeters. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.; 62 pages; $0.40.

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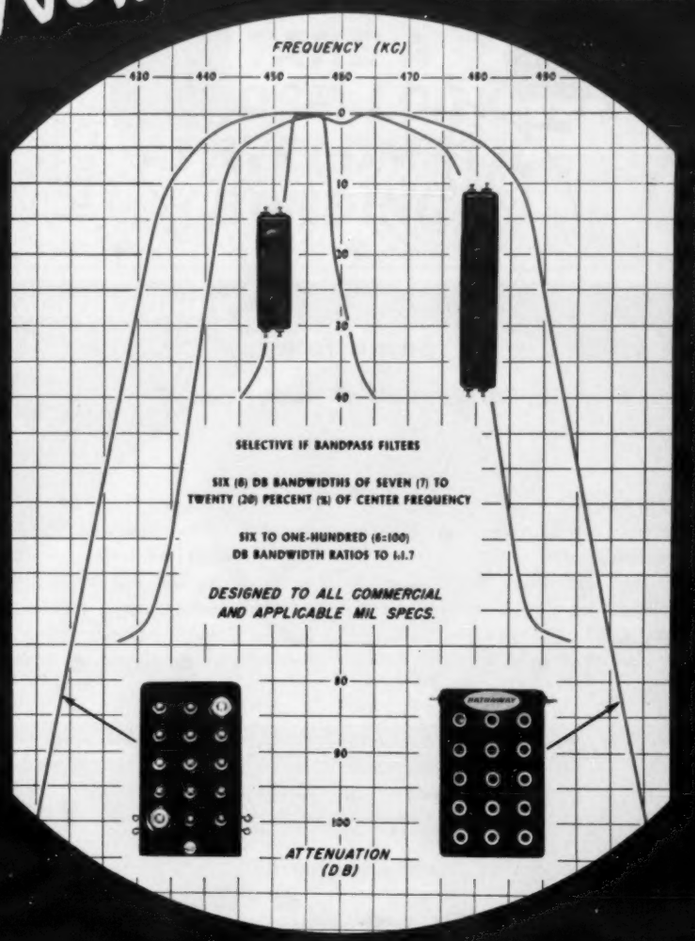
New HATHAWAY DENVER IF FILTERS



FOR RADIO COMMUNICATION AND NAVIGATION EQUIPMENT

- Exceptional selectivity
- Lightweight
- Temperature normalized
- High reliability
- Economically priced
- Filters in a wide range of specifications

Hathaway INSTRUMENTS INC.

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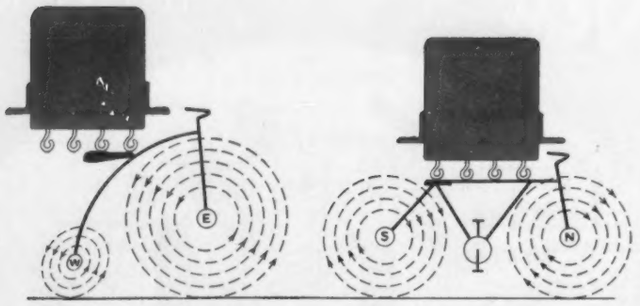
HATHAWAY DENVER
5812 EAST JEWELL AVENUE
DENVER 22, COLORADO

Please send me further information on the IF Filter.
My requirements are as follows:

Center Frequency ..... KC
3/6 DB Bandwidth ..... KC Min.
Selectivity ..... KC Max.
Bandwidth Ripple ..... DB Max.
Center Frequency Stability .....
Ambient Temperature .....

NAME .....
POSITION .....
COMPANY .....
STREET .....
CITY ..... STATE .....



some relays
are quite differential
from others

If you want something to happen when a predetermined difference exists between two signals, gather 'round. Almost every* available subminiature dual coil "differential" relay we know of must have the "trip" signal applied to a specific coil and consequently the "reset" signal to the other coil. The dilemma stems from the lack of symmetry between the two flux paths or magnetic circuits of such a dual coil relay (the total pole gap changes with armature position). In a situation like this it takes more power to move the armature in one direction than the other, and when normal safety margins are added to operating power levels the disproportion becomes extreme. If you've found yourself with a relay that is this choosy about how and whether it transfers its contacts, you know you have anything but "true differential operation".

In typical and magnanimous fashion, we will now present *THE SOLUTION*, hoping that in due course it will also sell some of our relays. For true differential operation, without the pitfalls, we commend to your attention our subminiature Series 32 DPDT dual coil magnetic latching relay. The moment there's 100 milliwatts more on one coil than the other — regardless of how gradually the differential has taken place — the contacts transfer synchronously and completely. Hang up, blackout and those other monstrous contact mistakes often brought on by "sliding current" signals are neatly avoided by the design and adjustment of the "32". Its magnetic circuits and flux paths are as symmetrical as grapefruit halves, the gap remains constant no matter what the armature position, and essentially 100% cancellation occurs between coils. The 30 g to 5000 cycles vibration (operating or non-operating), 100 g shock and constant acceleration, and −65° to +125°C. operating temperature ratings all hold true for the stated 100-milliwatt sensitivity. Safety margins needn't be added just to make the specs hold true in practice.

* * *

If you've never used two collector circuits of a bistable whats-it to drive a dual coil polarized relay differentially, who knows what joys may await you? Write to Sigma today, telling us your differential troubles.

*Except ours, of course.

SIGMA

SIGMA INSTRUMENTS, INC.
53 PEARL ST., SO. BRAINTREE 85, MASS.
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SCANNING PRESS RELEASES

• **MACH 2** (over 1300 mph) test drops have proved the value of the B-58 Hustler bomber's new two-component bomb and fuel pod. Drops have been made at altitudes ranging from 1000 to more than 40,000 ft, at both subsonic and supersonic speeds.

The slim-shaped Hustler was designed to carry its nuclear bomb and part of its fuel "outside" in a streamlined droppable pod slung beneath the fuselage. Bombers now in service with SAC have this single pod. The newer model consists of a small bomb pod, nested into the top of a large fuel pod. When the external fuel is expended, the pilot can shuck off the lower component like a pair of heavy shoes and streak on to the target, completing the mission with fuel from wing tanks.

TWO-COMPONENT POD is shown readied for flight—the lower component on handling trailer, the upper component mounted under aircraft. Upper component nestles into the canoe-like cavity of the lower component. When fuel pod is empty it is jettisoned, permitting the lightened bomber to dash toward its target at speeds of more than 1300 mph.

The Hustler can make its target dash at speeds of more than 1300 mph and at heights of more than 60,000 ft or approach in fast, low-level flight to escape enemy radar detection.

Tests have been under way at Nevada and New Mexico missile ranges, conducted by Convair Div. of General Dynamics Corp. and the Air Force.

High-torque, fast-reversing Barber-Colman a-c motors

(with or without gearheads)

Ideal for low-cost servo systems utilizing either transistor or vacuum-tube control, these compact, powerful shaded-pole motors are adaptable to a variety of electronic control circuits. In many systems they satisfactorily replace motors costing twice as much. Adaptable to split-phase capacitor operation . . . available with open or enclosed gear reductions . . . 2-phase or electronic control windings. Ratings are from .00015 to .04 hp. Fast-reversing low-inertia rotors . . . high starting torque . . . electrodynamic braking . . . quality guaranteed!

WRITE FOR NEW QUICK REFERENCE FILE

Gives typical specifications on the complete line of Barber-Colman a-c small motors: unidirectional, synchronous, reversible • With or without reduction gearing • Open or enclosed types Stator and rotor sets also available.

BARBER-COLMAN COMPANY
Dept. R, 1210 Rock St., Rockford, Illinois
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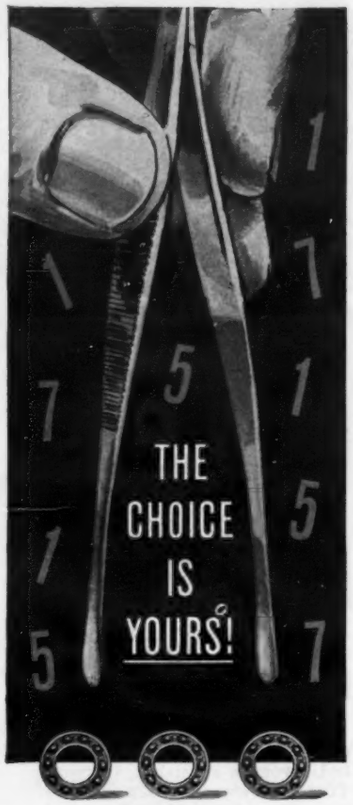

RMB

RMB miniature and instrument ball bearings are available in ABEC-1, ABEC-5 and ABEC-7 tolerances.

ONLY ONE OF THESE IS BEST FOR YOUR APPLICATION

For highly sensitive and high speed applications you'll choose the RMB ABEC-5 or -7 bearing.

For applications of less exacting requirements, you'll want to take advantage of the reduced cost of the RMB ABEC-1 bearing.

IT'S YOUR APPLICATION— YOU MAKE THE CHOICE

Find out more about the RMB line... Ask for Catalog 4E-1.

LANDIS & GYR, inc.
45 West 45th St.
New York 36, N. Y.

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• **LIGHTWEIGHT ALUMINUM SPHERES** that cost less than $1 each are charged with the task of testing multimillion-dollar super-radar systems developed by Sperry Gyroscope Co., Great Neck, N. Y.

Attached to balloons that soar hundreds of miles out to sea before bursting, spheres are practical, low-cost targets that can be sent aloft to check a radar unit's tracking performance.

After sphere is launched, an operator tracks it and faces antenna in direction of target's flight. The radar antenna automatically "locks on" target, just as a magnet is drawn to the North.

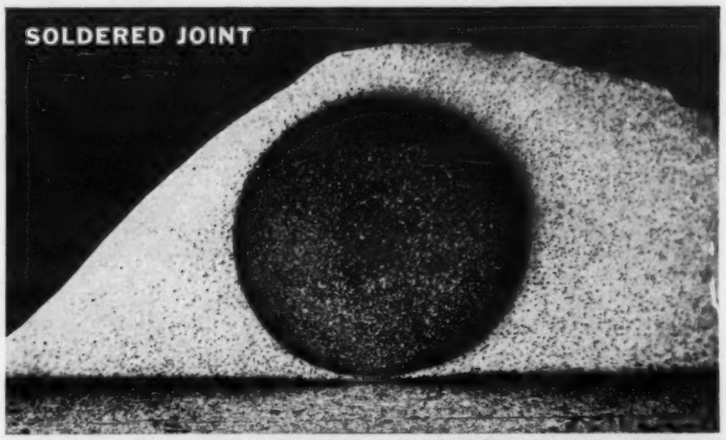
Crucial portion of the test now begins. The high-powered system must track the sphere, which is only 6 inches in dia, at great distances. To make the test more severe, the target constantly sways from a supporting line under balloon.

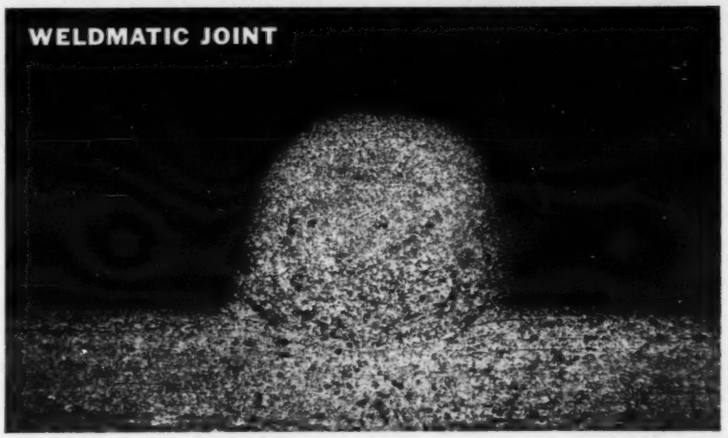
When the radar passes this rigorous trial, Sperry can virtually guarantee its accurate performance tracking any target under actual operational conditions.

Use of the balloons—which are employed primarily in checking out missile guidance and target-tracking radars for Navy Talos and Terrier missiles—is typical of the exhaustive procedures that the company employs in certifying the accuracy of its equipment.

Among major programs Sperry still has in development for future production is the target-tracking and discrimination radar system for the Army's Nike Zeus antimissile missile system.

TAKE A CLOSE LOOK AT WELDMATIC BONDING





Weldmatic Bonding takes the guesswork out of production reliability. With the complete metal fusion that results from Weldmatic impulse bonding, mechanical strength stays—and electrical juncture conductivity cannot change. The 50X microphotos above tell the story. Both cross-sections show 0.042" tinned copper wire resistor leads crossed at right angles. For detailed information and prices, plus weld evaluation report on your application, write 950 Royal Oaks Drive / Monrovia, California.

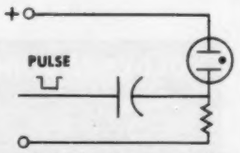
UNITEK
WELDMATIC DIVISION

Circle 113 on Reader-Service Card for more information

4 ways to use

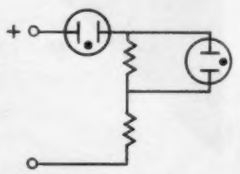
General Electric Glow Lamps as Circuit Components

1. As a MEMORY DEVICE, because of the differential between starting and operating voltages. Both the General Electric NE-96 and NE-97 are well suited for switching circuits and counters where they can function as transfer elements and as indicators of state or sequence.

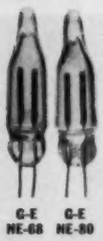


G-E Glow Lamp used in Memory Circuit

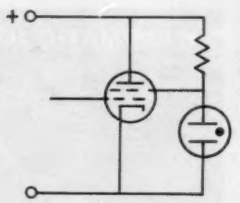
2. As a VOLTAGE INDICATOR, because of their critical starting voltage. The G-E NE-76 and the NE-81 are stabilized and selected for close tolerance on starting voltage. Both find use in gating circuits, logic matrices, switching circuits or as an indicator of input or output levels.



G-E Glow Lamps as Multiple Voltage Indicators

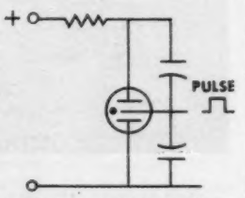


3. As a VOLTAGE REGULATOR, because of their constant operating voltage range. The General Electric NE-68 and its "first cousin", the G-E NE-80 (closer tolerance), function effectively wherever voltage regulation is required. (Glow Lamps for higher current applications are also available.)



G-E Glow Lamp used as a Voltage Regulator

4. As a TRIGGERED SWITCH. A low current signal applied to the trigger (third electrode) starts this lamp, permitting conductance of peak current surges up to 100 m.a. in the power circuit. It can be used in counting circuits or as a control device with photocells, thermostats or moisture sensors in trigger circuit.



G-E NE-77 in a Trigger Circuit

For more information, write for: Specification Sheet #3-092 "G-E Glow Lamps for Circuit Component Use". General Electric Co., Miniature Lamp Dept. M-126, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

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RELEASES

• **A 260,000-RPM AIR-BEARING**—air-turbine dental handpiece has been built and delivered to the Air Force by the Garrett Corp.'s AiResearch Mfg. Div., Phoenix, Ariz.

Highest speed air-bearing handpiece ever built, the unit marks completion of the half-way point in a program to build a similar, even higher rpm unit.

Extremely low vibration and noise levels are features of the handpiece. According to studies conducted by the USAF Aerospace Medical Center of Aviation Medicine, San Antonio, Tex., these are factors contributing to greatly lessened discomfort for dental patients and fatigue for the dentist. Higher speeds require almost no pressure and reduce tooth contact time by 75 percent.

Design feature of the unit is its combined pneumodynamic journal bearing and pinwheel air

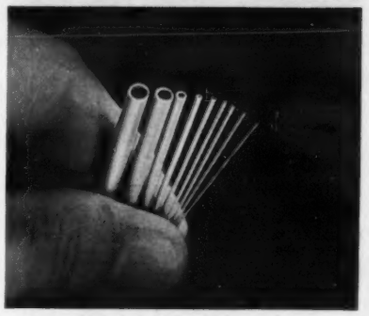
turbine. The 0.275-inch dia bearing has only millionths of an inch diametrical clearance.

To simplify geometry and fabrication, AiResearch adopted a unique approach to thrust bearing design, resulting in a combination hydrodynamic and hydrostatic bearing. Success of the design is proved by preliminary testing which shows no measurable bearing wear, indicating extremely long life.

The dental unit may be disassembled in seconds with any pointed instrument such as a probe. It may be sterilized in an autoclave and uses a standard dental compressed-air source.

The fingernail-sized dental unit, pinwheeling on jets of air, is itself one of the smallest turbines yet built.

NEED FINE TUBING IN ALUMINUM ALLOYS?



• Production mills provide rough drawn aluminum alloy tubing in the standard, large sizes. But the redrawing of fine, seamless tubing with any needed O.D. between 0.010″ and 0.375″ and wall thicknesses from 0.035″ ±0.0005″ to 0.001″ ±0.00025″ is UNIFORM's specialty. UNIFORM TUBES provides the precision aluminum alloy tubing such as that which goes into the fabrication of lightweight, highly accurate instrument pointers and other critical applications.

Through skills developed over the years and by continuing devotion to precision craftsmanship, UNIFORM meets close tolerances in every dimension even cutting tubing in lengths to ±0.003″. Tubing ends are always free of burrs and concentricity is preserved.

Fine tubing drawn to your specification is available in high purity aluminum and aluminum alloys 1080-C, 1100, 2024, 3003, 5052, 6061, 6951, 7075 and the new high-strength alloy UT-58.

Even though tubing is drawn to your exacting requirements, if you need delivery "yesterday," UNIFORM will produce fastest delivery possible. Write for information on this tubing or on tubular parts fabricated "at the mill" from these alloys as well as alloys of copper, nickel, steel and the precious metals. Sizes up to ⅜-inch O.D. on application.

UNIFORM TUBES, INC. COLLEGEVILLE 2, PA.
HUxley 9-7276 TWX CGVL 1044

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NOW...
ONE SOURCE FOR IMMEDIATE DELIVERY ON ALL YOUR
Vari-Speed Belt NEEDS

...FROM
LOVEJOY

Wide range of sizes from ⅞" to 3" top width

Nominal overall lengths from 26.4" to 170"

- **Fabricated from fiber-reinforced synthetic rubber**
- **Impervious to oil and heat**
- **Remain "live" under static conditions**
- **Stretch resistant properties of reinforcing cords assure length stability**
- **Constructed to withstand intense squeezing action of pulley sheave walls**

Get your copy of industry's most handy guide to the right variable speed belt for every application. *Ask for Catalog No. 61-C.*

Lovejoy — First Name in Power Transmission Equipment

LOVEJOY FLEXIBLE COUPLING CO.
4812 West Lake St. • Chicago 44, Ill.

Circle 116 on Reader-Service Card

• **A RADIO RECEIVER** which can pinpoint the spot where an astronaut in a space capsule has landed after orbiting the earth has been developed by ITT.

The receiver is used by patrol aircraft to pick up signals from a radio transmitter located in the space capsule. The received signals are displayed as a spot of light on the face of a small "picture tube" on the receiver. The position of the light on tube face indicates whether patrol aircraft is on course and enables the pilot to "home in" on the signal.

The device is designed to receive various types of signals known technically as continuous-wave (CW) signals, single-pulse signals and correlated double pulses. This versatility makes the equipment more reliable and results in greater safety for the astronaut.

Equipment was developed by ITT Kellogg Space Communications Laboratory, Ft. Wayne, Ind.

• **FIFTEEN-MILLION-YEN** (359 yen to $1) "Electronic Coach" sets the pace for Japan's Olympic trackmen in their building for the 1964 Olympic Games in Tokyo's National Athletic Stadium.

The coach runs on a rail laid along the inside of the track. Speed can be set in advance and controlled by magnetic tape or changed during the run by remote control from a central control room under the main stand at the stadium. The pace-setter is equipped with a radio receiver and a loudspeaker, which broadcasts instructions from the coach.

The unit was donated and installed by Tokyo Shibaura Electric Co.

WATLOW'S
FIREROD

OUTHEATS...
OUTLASTS...
OUTPERFORMS
ANY OTHER
CARTRIDGE HEATER!

OUTHEATS—because Watlow's FIREROD® produces up to eight times as much heat as any standard cartridge unit—or will give as much heat as a standard unit in ⅛th the space.

OUTLASTS—Watlow perfected the exclusive construction techniques that permits the FIREROD® to operate at lower internal temperatures. Better heat transfer from the resistance wire to the sheath permits high operating temperatures without excessive internal temperatures which cause burnouts. Laboratory and field tests have proven FIREROD'S® superiority when tested with *any other cartridge heater*, including competitive so called "high watts density" units.

OUTPERFORMS—Proven longer life—less replacements and down time—up to 8 times as much heat as other standard units or the same heat in ⅛th the space—and at a price only slightly higher than a standard unit. Deliveries two weeks or less.

WHEN YOU SPECIFY CARTRIDGE HEATERS SPECIFY WATLOW'S FIREROD

Bulletin 367 will give you complete information.

WATLOW
ELECTRIC MANUFACTURING CO.
1378 Ferguson Ave./St. Louis 14, Mo.

6102

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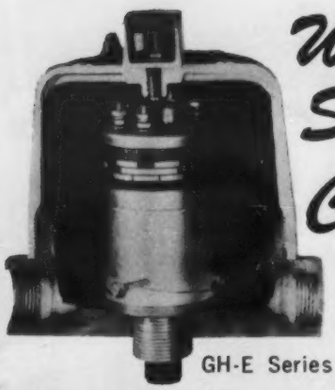

GH-E Series

Where Safety Counts

EXPLOSION PROOF

SPEED SENSITIVE SWITCHES

All GH series of cable driven governors and switches are available in this GH-E series. This housing meets the specifications for class 1 group D, Explosion Proof Equipment. For further information, write for Bulletin 504-A.

SYNCHRO-START PRODUCTS, INC.
8151 N. RIDGEWAY AVE., SKOKIE, ILL.

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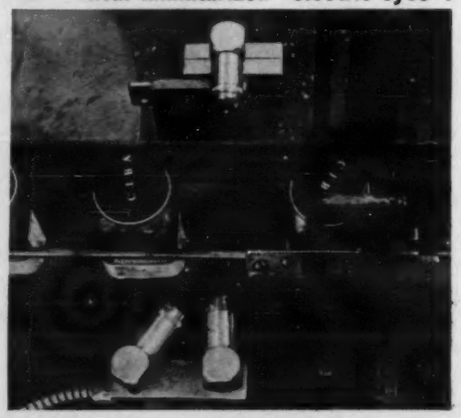
AUTOMATION at its best...

with miniaturized "electric-eyes"!



Here is a typical engineered job by PHOTOMATION. It is only one example of the many applications of miniaturized "electric-eyes" for inspecting, counting, registration, sorting, quality control and all phases of packaging.

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RELEASES

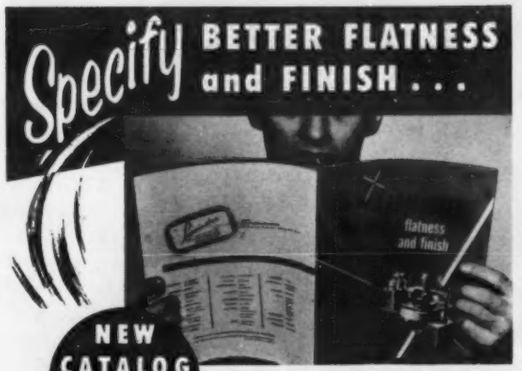
• **WHEN U. S. ASTRONAUTS** are able to maneuver freely in space, their air supply will possibly come from a device similar to that developed for the U. S. Navy by the Mine Safety Appliances Co., Pittsburgh, Pa.

In military language, the device is called the "individual atmosphere control unit". It is an integral part of a full pressure suit and rides on the wearer's back similar to an army full field pack.

The device continually regenerates the breathing gas mixture which surrounds a man inside a pressurized suit. It will supply the oxygen necessary to keep an astronaut alive in space for a sustained period of two hours.

The "Backpack" unit uses a battery-powered blower to circulate air through the pressure suit and apparatus. Heat and moisture are removed in a heat exchanger, which cools air through the process of water evaporation. Cooled air then passes into a canister of potassium or sodium superoxide—the heart of the system. Oxygen is added to the air and, simultaneously, carbon dioxide, odors and excess water are removed in one fast passage through the canister.

The purified air then is directed again through a heat exchanger for final temperature regulation before it is returned to the pressure suit.



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Get the answers to any questions you may have about product improvement through machine lapping. You'll see why you can specify a flatness of .0000116" and a finish of 2 to 3 AA and be sure that you'll be able to produce it on a production basis with the Lapmaster. Send for your copy of the new Lapmaster catalog.

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***New*...from MARSH!**

MARSH *Master-mite* **SOLENOID VALVES**

Conduit-type Master-mite. Grommet-type also available.

Small solenoid valves that fill a BIG order

Designed to meet the need for positive-acting tight-seating valves for use on wide variety of media, including oxygen, hydrogen, acetylene, etc.

Two Types:
Conduit type and grommet type. Port sizes 1/8" and 1/4" NPT.

Ten orifice sizes:
3/64" through 1/4".

Wide range of voltages:
Standard with 115 V. A. C. but also available in 12, 24, 208, 230, 460 V. A.C.

Pressure to 540 psi.

Small, but with more strength in the Marsh manner. Coils never overheat. Entire assembly leak tight. Remarkably quiet operation. Cleanable without breaking connections. Used in any position. Bodies either brass bar stock or 18-8 stainless steel. All moving parts stainless. Underwriters' approved for use on oxygen and hydrogen and as safety valves.

Write for new bulletin

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Division of Colorado Oil and Gas Corporation

Marsh Instrument & Valve Co., (Canada) Ltd., 8407 103rd St., Edmonton, Alberta, Canada. Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas. Eastern Seaboard Warehouse: Marsh Instrument Company, 1209 Anderson Ave., Fort Lee, N.J.

Circle 121 on Reader-Service Card for more information

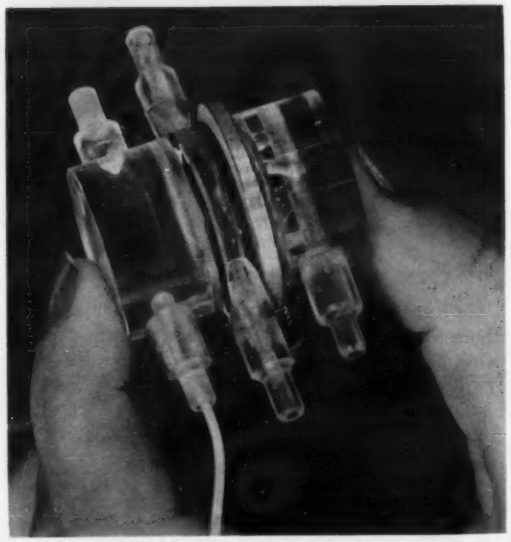
• **AN EXPERIMENTAL FUEL CELL**, not much larger than a man's wristwatch, some day may provide silent power for submarines and emergency power sources for missile bases.

The sodium-chlorine cell produces an open circuit voltage of 3.30v, and when bromine is used in the cell, voltage is 2.89v.

The cell is twice as powerful as the common flashlight battery.

Manufactured by Hoffman Electronics Corp., the cell produces 1w of power against ⅔w obtainable from the flashlight cell. The battery also has a limited life, whereas the fuel cell operates indefinitely because it is recharged continuously. It can be designed to deliver many thousands of kilowatts of power.

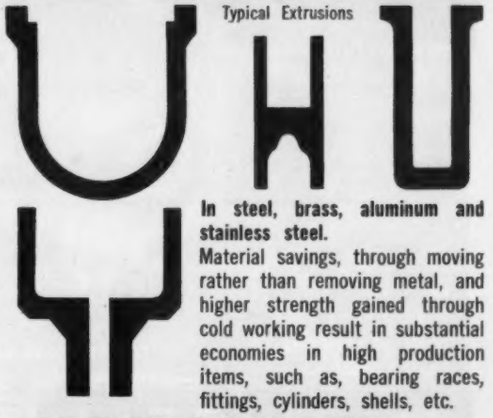
An interesting fact about this fuel cell is that when chlorine is used for the process of generating electricity from the chemical reaction, table salt of high purity is produced. When bromine is used as the oxidizer in the cell, the product is a component in "Bromo Seltzer" and in photographic developers.



POWER SOURCE OF FUTURE—This experimental fuel cell may be the ancestor of power units of the future which will propel submarines in silence and feed emergency power to missile bases.

COLD IMPACT EXTRUSIONS

Typical Extrusions



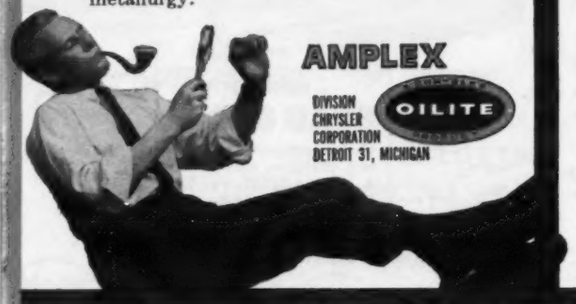
In steel, brass, aluminum and stainless steel.
Material savings, through moving rather than removing metal, and higher strength gained through cold working result in substantial economies in high production items, such as, bearing races, fittings, cylinders, shells, etc.

JACOBSON NUT MFG. CORP.
Kenilworth, New Jersey

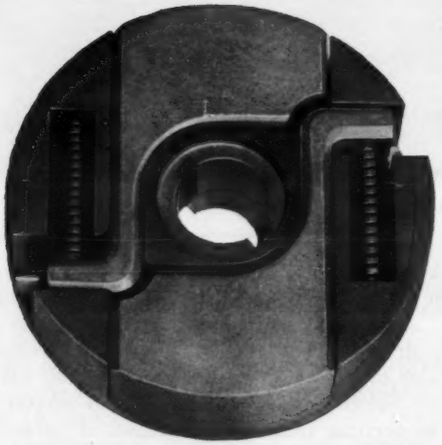
THE AMPLEXOLOGIST

comes through in the clutch

Manufacturer's Problem: What type of clutch to use in a new, self-propelled product. *Solution:* Call the Amplexologist. *Result (shown):* A unique, heavy-duty centrifugal clutch with only two spring-operated friction shoes. Designed with a minimum of moving parts. Produced at minimum cost through advanced powder metallurgy.



AMPLEX
DIVISION CHRYSLER CORPORATION DETROIT 31, MICHIGAN
OILITE



SEND FOR THE SECRET OF THE AMPLEXOLOGIST'S SUCCESS

1 ENGINEERING MANUAL
45 pages of technical information: How to determine correct applications for powder metal parts, bearings, filters.

2 NEW BEARING STOCK LIST
20 pages. 1066 standard sizes of Oilite self-lubricating bearings—bearing material. Selection guide, engineering data.

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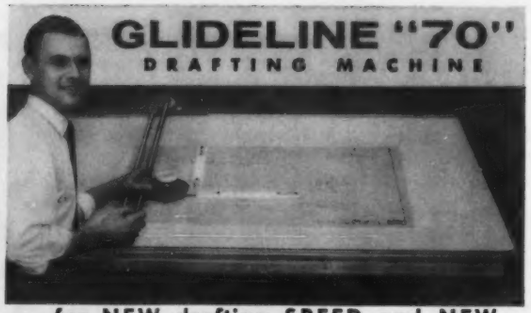

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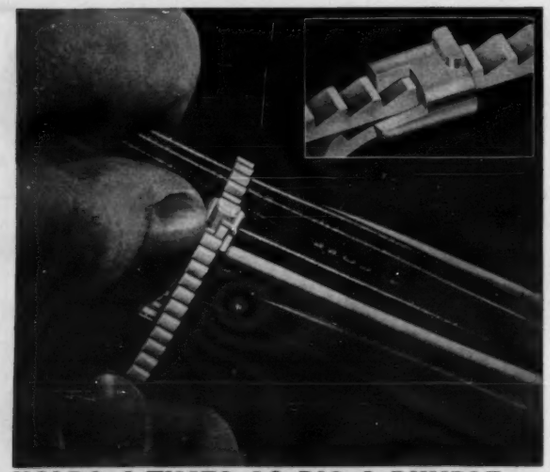

HOLDS 4 TIMES AS BIG A BUNDLE— HOLDS AT 50 G'S

Genuine Bund-L-Tite* nylon straps are twice as long and fully 10 times as strong as any other bundle-tying strap made. This means that you can secure larger bundles at greater stresses. Bund-L-Tite is fast and simple, too: just pull the self-locking strap around the wires. No tying, no knots, no hitches to come loose. Light-weight DuPont zytel meets MIL-P-17091. ⅛" size holds 40 lbs. tension; 3/16", 175 lbs.; ¼", 325 lbs. IMITATED BUT NOT DUPLICATED. Write for free literature.

DAKOTA ENGINEERING, INC.
4315 Sepulveda Blvd., Culver City, California

Manufacturer of Cab-L-Tite clamps.
*Trade Mark

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RELEASES

• **A REVOLUTIONARY RADAR** unit on B-52H missile launchers will give the U. S. Air Force Strategic Air Command bombers a "magic eye", allowing all-weather bombing or ballistic missile runs of more than 1000 miles at altitudes of less than 1000 ft.

Using radar scopes installed in the B-52H cabin, the Advanced Capability Radar Systems displays the terrain in front of the 650-mph bomber. The pilot then adjusts his flight path to insure clearance of the terrain, allowing safe "hedge-hopping" on bomb runs at high speeds.

Integration of the unit with the improved bombing-navigation system makes possible precision bombing from altitudes of more than 60,000 ft or hit-and-run raids conducted from "treetop" level.

The bombing-navigational system theoretically enables the eight-jet missile bomber to automatically fly to predetermined targets half-way around the world and drop its bomb loads within

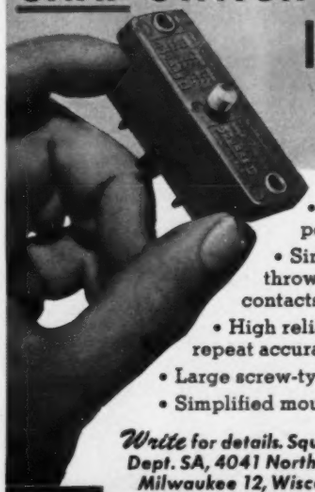
a 1000-ft radius, according to International Business Machines Corp., manufacturer of the system.

A complex computing system linking the aircraft's doppler radar and automatic astro compass with the IBM-controlled bombing system allows the autopilot to hold the 450,000-lb bomber on an unerring course for thousands of miles.

Combined with its added range, the B-52H is designed to carry four new solid-fuel Douglas Skybolt ballistic missiles, each capable of destroying major targets more than 1000 miles from the launching point.

The first of the new B-52H's is now in production for SAC at Boeing's Wichita Div.

NEW 2-POLE PRECISION *SNAP* SWITCH MOUNTS IN SMALL SPACE



- Same size as single-pole switch
- Single throw or double throw—double-break contacts
- High reliability—precise repeat accuracy—long life
- Large screw-type terminals
- Simplified mounting

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wherever electricity is distributed and controlled

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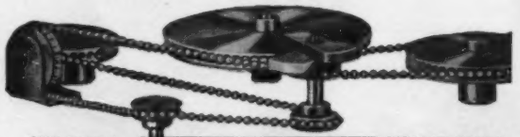
New! BEAD CHAIN DRIVES

Low-Speed, Positive Drives or Motion Transfer ... *At Far Less Cost!*

NOW—BEAD CHAIN—QUALIFIED FOR DRIVES

Swivel-like Bead Chain and special non-slip sprockets make any drive possible ... at low cost ... eliminates expensive gears, universal joints, etc. Perfect for inaccessible locations!



PULL CHAINS

Kinkless
BEAD CHAIN
Chain of a thousand uses! Low cost, attractive, easy to use! 5 Sizes: 3/32" to 3/16". Strengths 20 to 200 lbs.
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RETAINER CHAINS

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DOOR CHECK

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YOU can profit by our 78 years of experience in weaving wire.

YOUR specs, your delivery date, on mesh from 1¼" to 200 x 200—plus a complete line of precise filter weaves.

For information, address Dept. 22

THE C. O. JELLIFF MANUFACTURING CORPORATION
SOUTHPORT • CONNECTICUT

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• **SPECIAL SAFETY FEATURES** of this fork truck avert the danger of accidentally igniting a rocket's solid fuel.

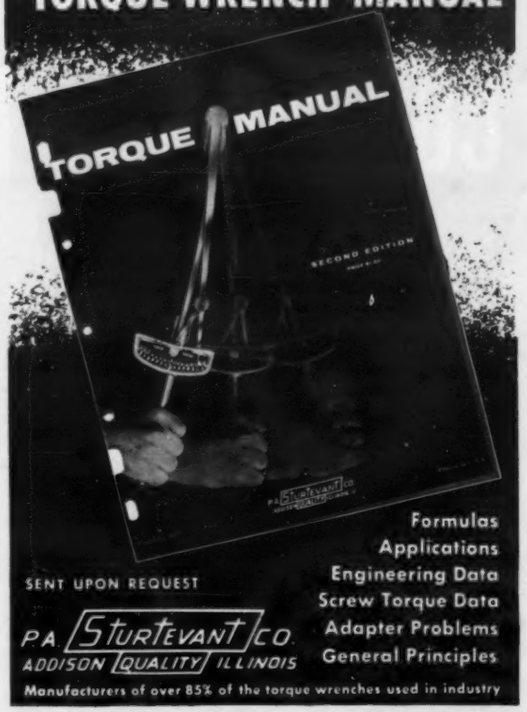
Third-stage rocket motors for Air Force Minuteman ICBM's are loaded for shipment by an 18,000-lb capacity truck.

The special fork truck was manufactured by the Industrial Truck Div. of Clark Equipment Co., Battle Creek, Mich.

The diesel-powered unit operates without an electrical system. The engine is started hydraulically and all gages are mechanical instead of electrical.

To prevent any chance of spark occurring, the truck has conductive rubber tires, aluminum fan blades, bronze carriage bushings, nickel-plated rollers in the carriage and upright, and a water muffler.

"TORQUE WRENCH" MANUAL



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1. UNLIMITED SPEED RANGE — from any desired maximum speed to zero, including reverse, without stopping motor.
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4. AUTOMATED SPEED CONTROL — control tension, proportion, synchronization, etc. from any control signal; 3 to 15 PSI, .5 to 5 ma, potentiometer, frequency, or binary signal from punch cards, tapes, or computers.

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GRAHAM TRANSMISSIONS, INC.
DEPT. 18 • MENOMONEE FALLS, WISCONSIN

Circle 129 on Reader-Service Card for more information

• **A FLEXIBLE BLANKET OF WATER** which can protect man and equipment against the searing temperatures of space-vehicle re-entries has been developed by scientists of the Astronautics Div. of Chance Vought.

The unique material is called "Thermosorb". It is composed of more than 90 percent water, yet has the handling characteristics of a solid.

Placed between the inner and outer walls of a space craft, Thermosorb can hold the inside temperature of the vehicle well within human tolerance limits while the temperature of the outside skin may be as high as 4000F.

The material has been used successfully in rockets to protect instruments and control-system components located in compartments immediately adjacent to rocket motor nozzles. Temperatures on the outer wall of nozzle reached 2200F but were held to less than 150F on the cool side of Thermosorb.

The invention resembles a cross between a piece of wet felt and a fine-grained cellulose sponge. It retains water with such tenacity that specimens have been subjected to 16G or 16 times their weight in a centrifuge without the water separating. Just what holds the water together, Chance Vought won't say.

Check with BARCO for LONG LIFE ROTARY JOINTS

BARCO is HEADQUARTERS for Rotary Joints!
Types . . . Sizes . . . Styles for every purpose:

Type C—Top performer in industry for dryers, dry cans, rolls, and drums. Threaded ends, ½" to 3". Syphon or single flow. Steam, water, oil, air, gas, or chemicals. Also Type CR for rotating syphon.

Type CF—Flanged end connection for easy installation. 1½", 2", 2½", 3". 200-225 psi.

Series 300—Large size, up to 2½" x 2½", 300 psi joints for circulating liquids. To 600° F.

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Types D - E—High speed, ball bearing ¼" rotary joints for hydraulic fluids, coolants, and compressed air on spindles, drills, and clutches.

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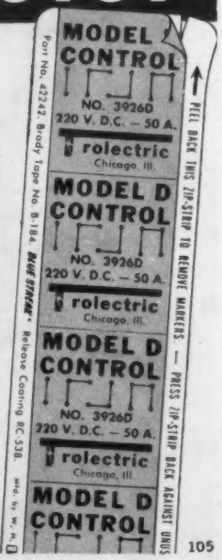
Brady self-bonding 5 mil aluminum foil Nameplates cost far less to buy. BIG savings in application time — *no heat, solvents, fasteners, or tools needed.* Permanent debossed-printed. Any wording, trademark, illustration. Mounted on handy Dispenser Cards—easy to inventory . . . protect plates from damage and loss.

*Write today for cost-cutting facts and samples of Brady C/M Nameplates.**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rolectric
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PEEL BACK THIS ZIP-STRIP TO REMOVE MARKERS — PRESS ZIP-STRIP BACK AGAINST GRID

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Manufacturers of Quality Pressure-Sensitive Industrial Tape Products. Est. 1914

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Gilman PRECISION SLIDE ASSEMBLIES

...available FROM STOCK in 132 standard types and sizes

LIGHT DUTY BASIC TYPE
HEAVY DUTY BASIC TYPE
LIGHT DUTY TYPE WITH RETURN SPRING
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LIGHT DUTY LEAD SCREW TYPE
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HEAVY DUTY CYLINDER POWERED (in-line mount)
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RUSSELL T. GILMAN, Inc.

613 Beech St. • Grafton, Wis.

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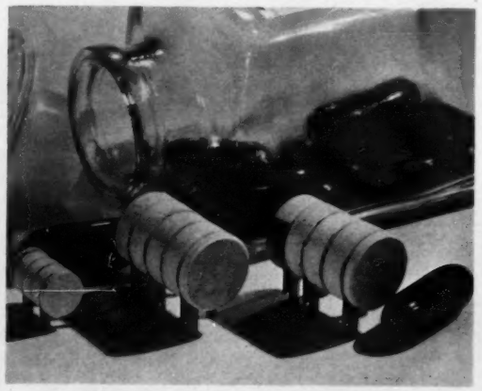
RELEASES

• **AMERICA'S FIRST ASTRONAUT** underwent a thorough and continuous physical checkup while in flight to enable doctors and scientists to study effects of the trip.

Tiny ceramic tubes, not much bigger than vitamin capsules, flashed back to earth the heartbeats of the astronaut as he hurtled through space aboard the Project Mercury capsule. The heartbeat signals and other body-process signals were amplified by three miniature ceramic vacuum tubes so that they were strong enough to travel back to radio receivers at tracking stations.

Special sensors attached to the spaceman's body picked up his heartbeats, pulse rate, breathing and temperature. They were relayed through wires built into his pressurized space suit to a miniature telemetry transmitter which contains the tubes.

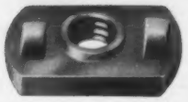


PILL-SIZED TUBES FOR SPACE are exactly like those used in a tiny transmitter to radio back to earth the heartbeats of America's first astronaut. Tubes make up the power-amplifier stages of the VHF transmitter.

The tubes make up the power amplifier stages of the VHF transmitter where they boost the strength of the signals to three or four watts—plenty of power to cover the distance. A single GE-type 7720 drives two 7296's in parallel to produce the output signal. The transmitter itself is only slightly larger than two packages of cigarettes and weighs less than 1 lb.

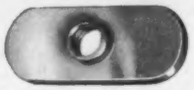
General Electric's Receiving Tube Dept., Owensboro, Ky., developed and makes the ceramic tubes. Texas Instruments, Inc., is the manufacturer of the telemetry transmitter, and Collins Radio Corp. has overall responsibility for Project Mercury capsule communications.

OHIO WELD NUTS



Patent 2908310

RN NUT — for projection welding. Ideal where tension is against the weld.



ND NUT — for spotwelding. Used where large nut is needed for bridging two sheets or for extra strength.

PN NUT — for projection welding. Ideal in confined areas, on heavier gages, or on curved surfaces.

Patent Applied For

XN NUT — for spotwelding, with recessed target electrode area. Full range of sizes can be welded with 20 KVA Welder.

Thread sizes #6-32 to ⅜-16

Samples and information furnished upon request.

The OHIO WELD FASTENERS Primary Fastener in Fastener Assemblies

THE OHIO NUT AND BOLT CO.

29 FIRST STREET BEREA, OHIO

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New Rotary Joint for Water Service

APPROXIMATELY ACTUAL SIZE

Smaller in Size, Weight and Price

Fits close quarters, tough service conditions on printing presses, calenders, waxers, embossers, ball mills, etc. No packing, no lubrication or adjustment, no external supports. Nickel-plated to resist rust, friction, wear. New special process makes seal rings harder, denser. Only 4 internal parts for easy field servicing. For all high speed service, pressures to 150 lbs. Six sizes: ⅜", ½" and ¾" N.P.T. or ⅜", ¾" and ⅞" N.F. Machine threads. Write for catalog information on new 4000 series.

THE JOHNSON CORPORATION

831 Wood St., Three Rivers, Michigan

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• **NAVY'S NEWEST** Fleet Ballistic Missile submarine, designed to fire the long-range 1500-mile Polaris, will slide down the launching ways at General Dynamics Corp.'s Electric Boat Div. June 15.

She is the Thomas A. Edison, a sister ship of the Ethan Allen now being readied for commissioning this summer at the Groton, Conn., atomic submarine shipyard. Larger than the first two FBM (Fleet Ballistic Missile) submarines now on duty—the USS George Washington and USS Patrick Henry — the Edison is 410 ft long and displaces 6900 tons. She will carry 16 nuclear-tipped Polaris missiles in midships tubes.

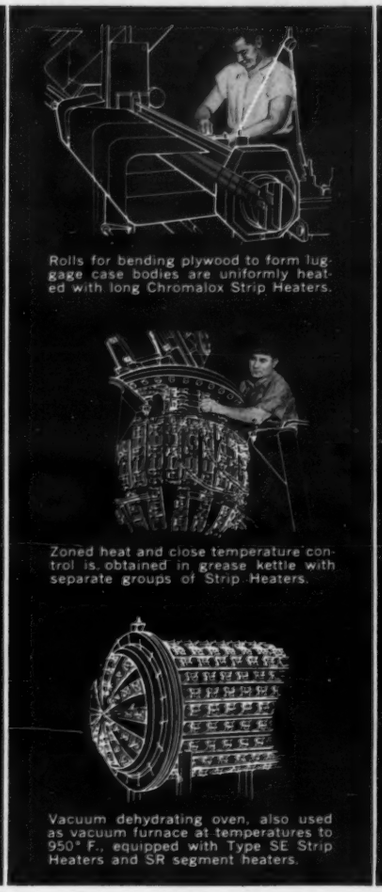
Meetings

Los Angeles, Calif. June 19-22	MIDYEAR MEETING, American Rocket Society and Institute of the Aero-Space Sciences.
Atlantic City, N. J. June 25-30	ANNUAL MEETING, American Society for Testing Materials, Chalfonte-Haddon Hall.
Lexington, Ky. June 26-30	ANNUAL MEETING, American Society for Engineering Education, University of Kentucky.
Boulder, Colo. June 28-30	JOINT AUTOMATIC CONTROL CONFERENCE, Institute of Radio Engineers, American Institute of Chemical Engineers, Instrument Society of America, American Institute of Electrical Engineers and American Society of Mechanical Engineers, University of Colorado.
Seattle, Wash. July 4-7	ANNUAL MEETING, National Society of Professional Engineers, Olympic Hotel.
Fort Collins, Colo. July 10-14	INSTITUTE IN TECHNICAL AND INDUSTRIAL COMMUNICATIONS, Colorado State University.
Portland, Ore. Aug. 14-17	NATIONAL WEST COAST MEETING, Society of Automotive Engineers, Sheraton Hotel.
Ann Arbor, Mich. Aug. 15-17	CRYOGENIC ENGINEERING CONFERENCE, University of Michigan.

CHROMALOX ELECTRIC STRIP HEATERS

Versatile, dependable, uniform heat for your product or processing needs

Chromalox Strip Heaters, sheathed in iron, chrome steel and Monel, come in sizes and types for every need. 4" to 96" lengths, 1" to 2½" widths. Also available in full rings and segments.



Rolls for bending plywood to form luggage case bodies are uniformly heated with long Chromalox Strip Heaters.

Zoned heat and close temperature control is obtained in grease kettle with separate groups of Strip Heaters.

Vacuum dehydrating oven, also used as vacuum furnace at temperatures to 950° F., equipped with Type SE Strip Heaters and SR segment heaters.

Aluminum extrusion container heated by curved Strip Heaters around circumference and Chromalox Cartridge Heaters in holes closer to billet.

Brake-lining bonding oven equipped with three SE Strip Heaters and a Ring Heater to produce uniform bond.

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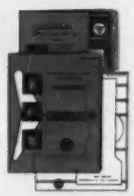

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Value Analysis Fact Sheet

ANACONDA FREE-CUTTING BRASS ROD

Not the plain old work horse many think, it can be produced with a variety of valuable properties—in addition to high machinability—to do many special jobs better, and at lower cost.

For the great majority of high-speed screw machine jobs, free-cutting brass rod is a standard shelf item.

But in an increasing number of jobs, the free-cutting property alone is not enough. Deep drilling to close tolerances, roll-threading, knurling, staking, slotting, etc., call for uniformity in a variety of other property combinations.

Fortunately free-cutting brass is a unique "on the fence" alloy (see Metallurgical Comment at the right) that can be adapted to answer these new demands—help screw machine operators meet increasingly rigid requirements and utilize cost-saving practices.

Specialized applications. Over the past several years, Anaconda American Brass has introduced several refinements into the usual mill practice for free-cutting brass and has developed different rods for specialized applications. In most instances, these rods will still meet ASTM and Government specifications.

Chip breaking. For the user who demands a rod with uniform ability to break up into small chips, an alloy is supplied which regularly contains substantial quantities of beta. This, because it is brittle at room temperature, adds to the chip-breaking ability of the lead already there. This rod is, therefore, particularly good for high-speed forming and drilling applications. On the other hand, it is the least ductile and can therefore be formed and headed to the least extent.

Cold forming. The usual and more numerous special applications require uniform ability to be cold-worked—as in roll-threading, knurling, heading, and other deforming. Properties of these special rods are refined by heat treatment or special drawing operations so that the rod can be consistently cold-worked. Normally, there is little sacrifice in machinability, but there is some loss in the ability of the rod to break into small chips.

Deep drilling. In small rod particularly, there has been an increasing demand for material that can be drilled to close tolerances. Special drawing and heat treating practices were developed to produce a rod which performs uniformly, even in such exacting applications as ball point pen tips.

High Strength. And for those applications calling for uniformly higher strength than the usual material, there is a rod produced by special drawing practices.

Technical assistance. If you have a special problem—whether it involves a variation of free-cutting brass or another free-cutting or engineering copper alloy—call in your Anaconda American Brass representative. He'll make available to you the experience and services of metallurgical and mill specialists. Or write: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 6148

FOR MORE INFORMATION about Anaconda Rods for Screw Machine Products—including physical properties, mechanical properties, composition and machinability — write for Publication B-14. Address: Anaconda American Brass Company, Waterbury 20, Connecticut.

Metallurgical Comment

Free-Cutting Brass can provide relatively wide variations in temper and ductility within the range of composition defined in ASTM and Government specifications (60 to 63% Cu, 2.5 to 3.7% Pb, remainder Zn).

In the commonly available rod temper, referred to in ASTM specifications as "half hard" and more commonly in the trade as "hard," tensile strength may range from 50,000 to 70,000 psi, depending on the rod size and the manufacturer.* And there can be a comparable variation in cold-working properties.

Here's why. The range of 60 to 63% copper was selected for free-cutting brass because it is the lowest which can be used to produce an alloy that can be hot-worked readily and also cold-worked. This means a brass that can be hot-extruded down to small sizes—and that later can be cold-worked to a modest degree.

In more technical terms, free-cutting brass is at the transition point between the alpha phase (the ductile form of the alloy) and the beta phase (the form that's hard and brittle at room temperature but readily worked when hot). Thus, relatively minor changes in composition and fabrication practices can make substantial shifts in the proportion of alpha and beta grains—hence in strength and ductility. Various combinations of these properties can be maintained uniformly by careful control of mill practices.

Free-cutting property of the alloy is, of course, provided by lead dispersed through it—and is not materially affected by changes in other properties.

Standard Anaconda Free-Cutting Brass-271 has a composition of 61.50% Cu, 3.25% Pb, 35.25% Zn. This composition and the mill procedures used are designed to provide a rod which will fit the great majority of high-speed screw machine work.

*In special hard temper the tensile strength of small sizes will approach 90,000 psi.

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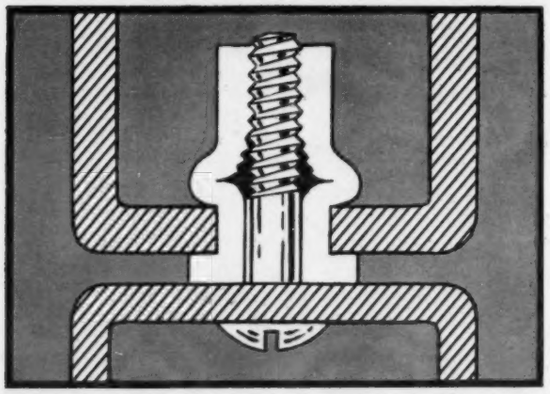

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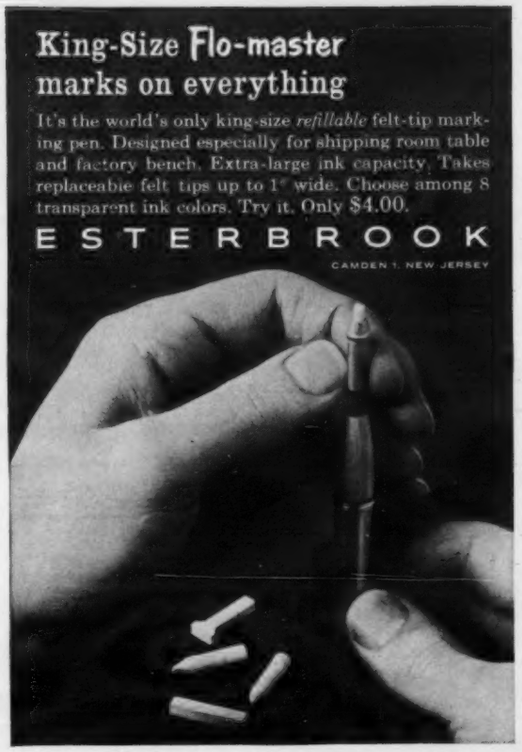
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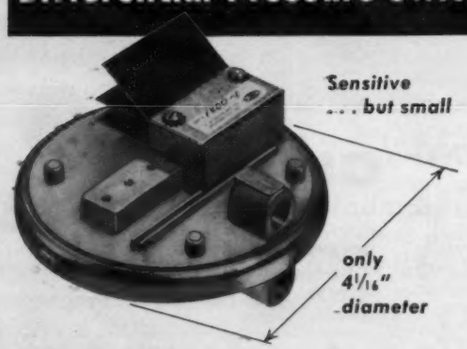

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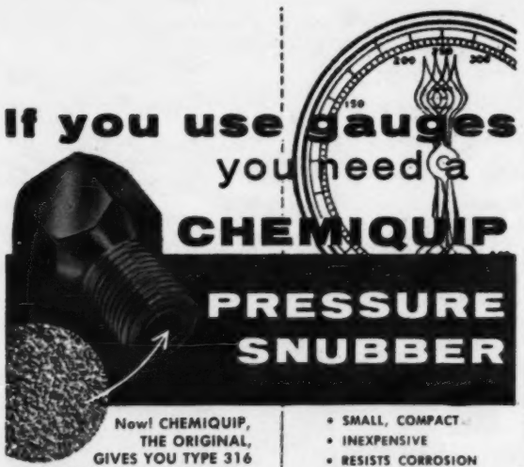

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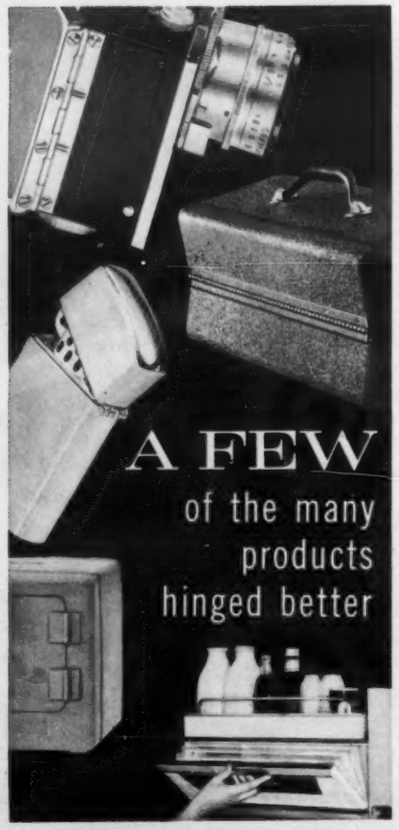

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Space-Age Sidelights

Please Don't Smile

Unless they invent a toothpaste for men who can't brush between long space missions, our astronauts may return to earth wearing mighty green grins. In addition to not being able to brush their teeth on long voyages, the spacemen will probably have to make the months- or years-long trips without either shaving or bathing.

Researchers at Aerojet-General Corp. point out that experiments show that dentifrices cause too great a "foaming" problem for water recycling systems.

And shaving soaps, it is feared, would harm a spaceship's bacterial digestion system. (Why not an electric razor? Because in the "weightless" state of space travel, the whisker fragments would be a big dust problem.)

The rugged, well-bathed and barbered adventurers who start out as a carefully selected, favored few, will probably return as a rather unfavorable phew.

Yellow, But Not Chicken

Those legendary little green men from Mars have been spared an equally unsightly spectacle—yellow men from earth. At one time, scientists thought man on deep space missions would eat nothing but "algae", but now, say planners at Aerojet-General Corp., it has been learned that this Space-Age Spinach, among other things, would turn man bright yellow. Air Force estimates say algae might, however, provide up to about 30 percent of the diet. Our astronauts won't have a yellow streak when they start out, but they may have when they return.

40,000 Winks

Scientists are now trying to find a way to make men hibernate so they can withstand the acceleration stresses of space travel at millions of miles an hour.

Dr. Bernard Black-Schaffer of the University of Cincinnati reports that animals, and eventually man, can tolerate acceleration stresses more easily if they are immersed in fluid-filled bags. To keep them from drowning, he cools the animals to a state of suspended animation in which no breathing is required. If you have got to go, you might just as well sleep on the way.

Cash Only, No Credit

A top U. S. propulsion expert says it would cost the average 150-lb American male between $150,000 and $450,000 for a ticket to orbit the earth in a space vehicle, at current costs.

R. C. Truax of Aerojet-General Corp. blamed the current high cost for putting one pound in an earth orbit on the fact that vehicles are used for only one flight.

Mr. Truax mentioned a plan now under study at Aerojet's plants near Sacramento, Calif. He described a gigantic two-stage rocket which would be built in a shipyard and launched at sea. Both stages would be recoverable, reducing the price of one pound in orbit to around $2.

Wonder if that's figured on a one-way or round-trip basis?

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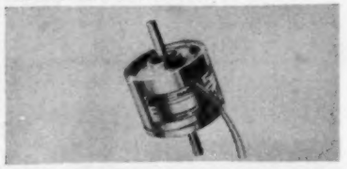

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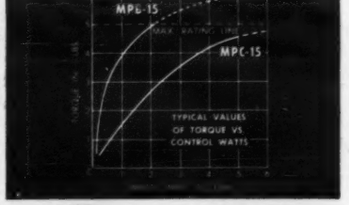

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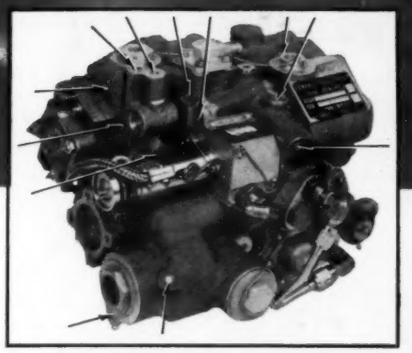

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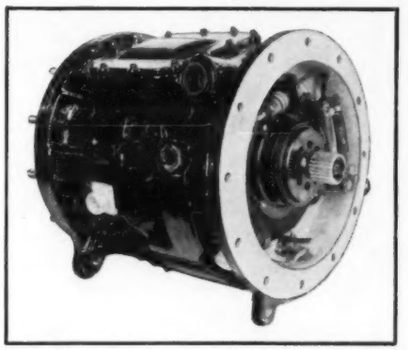

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